

Scilab Textbook Companion for
Fluid Mechanics With Engineering
Applications
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Book Description

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Scilab numbering policy used in this document and the relation to the above book.

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

AP Appendix to Example(Scilab Code that is an Appednix to a particular Example of the above book)

For example, Exa 3.51 means solved example 3.51 of this book. Sec 2.3 means a scilab code whose theory is explained in Section 2.3 of the book.

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Chapter 1

new

Scilab code Exa 1.1 example 1

```
1  clc
2  // Initialization of variables
3  sw=62.4 //lb/ft^3
4  sw2=9.81 //kN/m^3
5  sg=13.55 //No units
6  g=32.2 //ft/s^2
7  // calculations
8  dwater=sw/g
9  dwater2=sw2/(9.81)
10 Gmercury=sg*sw
11 Gmercury2=sg*sw2
12 dmercury=sg*dwater
13 dmercury2=sg*dwater2
14 // Results
15 printf('Density of water = %.2f slugs/ft^3',dwater)
16 printf('\n Density of water = %.2f g/ml',dwater2)
17 printf('\n Density of mercury = %.1f slugs/ft^3',
    dmercury)
18 printf('\n Density of mercury = %.2f kN/m^3',
    dmercury2)
19 printf('\n Specific weight of mercury = %d lb/ft^3',
```

```

    Gmercury+1)
20 printf('\n Specific weight of mercury = %d kN/m^3',
    Gmercury2+1)

```

Scilab code Exa 1.2 Example 2

```

1  clc
2  // Initialization of variables
3  T=460+100 //R
4  P=15 //psia
5  MW=32 //lb
6  g=32.2 //ft/s^2
7  ratio=0.4
8  // Calculations
9  R=49710/32
10 d=P*144/(R*T)
11 Gamma=d*g
12 volume=1/d
13 P2=P*(1/ratio)^1.4
14 P2f=P2*144
15 T2=P2f*ratio/(d*R) -460
16 P3=P/ratio
17 // Results
18 printf('part a')
19 printf('\n Density of oxygen = %.5f slug/ft^3',d)
20 printf('\n Specific weight of oxygen = %.2f lb/ft^3',
    ,Gamma)
21 printf('\n Specific volume of oxygen = %d ft^3/slug',
    ,volume+1)
22 printf('\n part b')
23 printf('\n Final pressure of oxygen = %.1f psia ',P2
    )
24 printf('\n Final Temperature of oxygen = %d F ',T2
    +2)
25 printf('\n part 3')

```

```
26 printf('\n Final pressure of oxygen = %.1f psia ',P3
    )
27 printf('\n Final Temperature of oxygen = %d F ',T
    -460)
```

Scilab code Exa 1.3 Example 3

```
1 clc
2 // Initialization of variables
3 P=600*1000 //N/m^2
4 T=25//C
5 M=71 //Kg
6 // Calculations
7 R=8312/M
8 d=P/(R*(273+T))
9 Gamma=d*9.81
10 v=1/d
11 printf('Density of chlorine = %.1f kg/m^3',d)
12 printf('\n Specific weight of chlorine = %d N/m^3',
    Gamma+1)
13 printf('\n Specific volume of chlorine = %.3f m^3/Kg
    ',v)
```

Chapter 2

new1

Scilab code Exa 2.1 Example 1

```
1  clc
2  // Initialization of variables
3  z=20000 //ft
4  rate=-0.00356 //F/ft
5  T=59 //F
6  P=14.7 //psia
7  gamma=0.076 //lb/ft^3
8  // calculations
9  P2=P*144 - gamma*(z)
10 P2f=P2/144
11 P3=P*exp(-gamma*z/(P*144))
12 P4=((P*144)^0.285 -0.285*gamma*z*(P*144)^(-0.715))
    ^(1/0.285)
13 P4f=P4/144.
14 P5=P*((460+T)/(460+T+rate*z))^(gamma*(T+460)/(P*144*
    rate))
15 // results
16 printf('Constant density ')
17 printf('\n Final pressure = %.2f psia ',P2f)
18 printf('\n Isothermal ')
19 printf('\n Final pressure = %.2f psia ',P3)
```

```

20 printf('\n Isentropic ')
21 printf('\n Final pressure = %.2f psia ',P4f)
22 printf('\n Linear decrease ')
23 printf('\n Final pressure = %d psia ',P5+1)

```

Scilab code Exa 2.2 Example 2

```

1  clc
2  // Initialization of variables
3  wA=53.5 //lb/ft^3
4  wA2=8.4 //kN/m^3
5  wB=78.8 //lb/ft^3
6  wB2=12.3 //kN/m^3
7  PB=30 //psi
8  PB2=200 //kN/m^2
9  AB=1.3 //ft
10 AB2=40/100 //m
11 BC=6.5 //ft
12 BC2=2 //m
13 CD=10 //ft
14 CD2=3 //m
15 // Calculations
16 PAbyGB=PB*144/wB - AB*13.55*62.4/wB - (BC+CD) + (AB+
    BC)*wA/wB
17 PA=PAbyGB*wB/144.
18 PAbyGB2=PB2/wB2 - AB2*13.55*9.81/wB2 - (BC2+CD2) + (
    AB2+BC2)*wA2/wB2
19 PA2=PAbyGB2*wB2
20 // Results
21 printf('English units ')
22 printf("\n Final pressure = %.1f psi",PA)
23 printf('\n SI Units ')
24 printf("\n Final pressure = %d kPa",PA2+1)

```

Scilab code Exa 2.3 Example 3

```
1  clc
2  // Initialization of variables
3  W=500 //lb
4  width=2 //ft
5  len=4 //ft
6  CGx=1.2 //ft
7  CGy=0.9 //ft
8  theta=30 //degrees
9  gam=62.4 //lb/ft^3
10 // Calculations
11 Fv=width*len //multiply by gam*x
12 F=width/(2*cosd(theta)) //multiply by gam*x*x
13 //function [y] =yp(x)
14 //      y=x/(2*cosd(theta)) + width*(x/cosd(theta))
      /(12*(cosd(theta))^4)
15 //endfunction
16 //function [M]=func(x)
17 //      M=F*gam*x^2 *0.770*x/2 +W*CGx - Fv*gam*x*width
18 //endfunction
19 x= poly(0, 'x');
20 vector=roots(F*gam*x^2 *0.770*x/2 +W*CGx - Fv*gam*x*
      width)
21 printf('The gate will remain closed between %.2f ft
      and %.2f ft ',vector(3),vector(2))
```

Scilab code Exa 2.4 Example 4

```
1  clc
2  // Initialization of variables
3  z1=1 //in
```

```

4 z2=2 //in
5 z3=2 //in
6 sOil=0.8
7 sWater=1
8 Pa=3 //psi
9 //calculations
10 Pd=(Pa) + (z2+z1)*sOil*62.4/144 + 62.4*z3/144
11 Fa=Pa*144*%pi*z3^2
12 Fb=sOil*62.4*(z2+z1-(z2+z3)*z2/((z2+z1)*%pi))*(%pi*
    z3^2 /2)
13 Fc=sOil*62.4*(z2+z1)*(%pi*z3^2 /2)
14 Fd=62.4*(z2+z3)*z2/((z2+z1)*%pi)*(%pi*z3^2 /2)
15 F=Fa+Fb+Fc+Fd
16 yPa=z2+z1
17 yCb=z2+z1-(z2+z3)*z2/((z2+z1)*%pi)
18 ICb=%pi*(z2+z3)^4 /128 -0.5*%pi*z2^2 *((z2+z3)*z2/((
    z2+z1)*%pi))^2
19 yPb=yCb+ICb/(yCb*0.5*%pi*z2^2)
20 yPc=z2+z1+ (z2+z3)*z2/((z2+z1)*%pi)
21 ICd=ICb
22 yPd=z2+z1 + (z2+z3)*z2/((z2+z1)*%pi) + ICb/((z2+z3)*
    z2/((z2+z1)*%pi)*0.5*%pi*z3^2 )
23 yP=(Fa*yPa+Fb*yPb+Fc*yPc+Fd*yPd)/F
24 //Results
25 printf('case 1')
26 printf('\n Pressure at the bottom = %.1f psi',Pd)
27 printf('\n case 2')
28 printf('\n Net force = %d lb ', F+3)
29 printf('\n Location of net force= %.2f ft ', yP)

```

Scilab code Exa 2.5 Example 5

```

1 clc
2 //Initialization of variables
3 dia=4 //m

```

```

4 P=35 //kN/m^2
5 theta=30 //degrees
6 // Calculations
7 Fx=P*(dia-dia*(1-cosd(theta))/2.)
8 Fz=P*dia*sind(theta)/2
9 dist=(dia-dia*(1-cosd(theta))/2.)
10 Fxb=9.81*dist*dist/2
11 Fzb=9.81*((180+theta)*%pi*(dia/2)^2/360 + sqrt(3) /2
    + dia/2)
12 // Results
13 printf('part a')
14 printf('\n Horizontal force= %.1f kN/m to the right'
    , Fx)
15 printf('\n Vertical force = %.1f kN/m upward' , Fz)
16 printf('\n part b')
17 printf('\n force by the fluid = %.1f kN/m to the
    right',Fxb)
18 printf('\n weight of the cross-hatched volume of
    liquid =%.1f kN/m Upward',Fzb )

```

Scilab code Exa 2.6 Example 6

```

1 clc
2 // Initialization of variables
3 d1=4 //in
4 h1=3.75 //in
5 w1=0.85 //lb
6 gamma=52 //lb/ft^3
7 d2=5 //in
8 depth=3 //in
9 // Calculations
10 A=[(d1/2)*(d1/2), -(d2/2)*(d2/2)+(d1/2)*(d1/2) ;
    1,1]
11 b=[0;w1*12*(12*2/d1)^2 /(gamma*%pi)]
12 C=A\b

```



```
13 x=C(1,1)
14 y=C(2,1)
15 height=depth-x
16 //Results
17 printf('Bottom of the cylinder will be %.2f in above
        the bottom of hollow cylinder',height)
```

Scilab code Exa 2.7 Example 7

```
1 clc
2 //Initialization of variables
3 v=180 //m/s
4 angle=40 //degrees
5 a=4 //m/s^2
6 r=2600 //m
7 g=9.81 //m/s^2
8 //calculations
9 //Assume outward and right as positive
10 an=-v*v/r
11 at=-a
12 ax=at*cosd(angle) +an*sind(angle)
13 az=at*sind(angle) -an*cosd(angle)
14 tangent=ax/(az+g)
15 theta=atand(tangent)
16 //Results
17 printf('Angle made by the free liquid = %.2f degrees
        ',-theta)
```

Chapter 3

new3

Scilab code Exa 3.1 Example 1

```
1  clc
2  // Initialization of variables
3  Q=0.5 // cfs
4  d1=8 // in
5  d2=4 // in
6  R=2 // in
7  h=0.59 // in
8  // calculations
9  Aa=%pi*(d1/12)^2 /4
10 Va=Q/Aa
11 Ab=2*%pi*R*h/144
12 Vb=Q/Ab
13 // results
14 printf("Average velocity at section A =%.2f fps ",Va
    )
15 printf("\\n Average velocity at section B=%.2f fps ",
    Vb)
```

Scilab code Exa 3.2 Example 1

```
1 clc
2 //Initialization of variables
3 Q=0.5 //cfs
4 d1=8 //in
5 d2=4 //in
6 R=2 //in
7 theta=45//degrees
8 //calculations
9 h=(1-cosd(theta)) //Multiply by r
10 Aa=2*%pi*h //Multiply by r^2
11 V=Q/Aa //divide by r^2
12 aA=0
13 r=0.167 //ft
14 V1=V/r^2
15 dvbydx=V*2/r^3
16 aB=V1*dvbydx
17 //results
18 //The answer varies a bit from the text due to
   rounding off error
19 printf("Acceleration at A = %d since flow is steady"
   ,aA)
20 printf("\\n Acceleration at B = %d ft/s^2",aB)
```

Chapter 4

new4

Scilab code Exa 4.1 Example 1

```
1  clc
2  // Initialization of variables
3  d=1.26
4  d=25 //in
5  d2=60 //cm
6  Q=25 //cfs
7  Q2=700 //L/s
8  dout=12 //in
9  dout2=30/100 //m
10 z=3 //ft
11 z2=1 //m
12 P1=45 //psi
13 P2=300 //kN/m^2
14 gamma=9.81 //kN/m^3
15 // calculations
16 V1=d/%pi
17 V2=d*4/%pi
18 pf=(P1*144/(1.26*62.4) + (V1^2)/64.4 - V2^2 /64.4 +z
19     )*1.26*62.4/144
20 V1=Q2/1000/(%pi*dout2^2)
21 V2=4*V1
```

```

21 p2f=((P2/(1.26*gamma)) + V1^2 /(2*gamma) -V2^2 /(2*
    gamma) +z2)*1.26*gamma
22
23 //results
24 printf("English units")
25 printf("\n Pressure at point 2 = %.1f psi ",pf)
26 printf("\n SI Units")
27 printf("\n Pressure at point 2 = %.d kN/m^2 ",p2f)

```

Scilab code Exa 4.2 Example 2

```

1 clc
2 //Initialization of variables
3 h=20 //m
4 c=4187 //N m /(kg K)
5 g=9.81
6 //calculations
7 dT=g*h/c
8 //results
9 printf("Increase in temperature of water = %.3f K",
    dT)

```

Scilab code Exa 4.3 Example 3

```

1 clc
2 //Initialization of variables
3 sg=1.26
4 sg2=1.26
5 HP=22
6 HP2=16
7 //calculations
8 hp=HP*550/(sg*62.4) //divide by Q
9 Q=14.2 //cfs

```

```

10 printf("In English units , By trial Q= %.1f cfs",Q)
11 hp2=HP2*1000/(sg2*9.81)
12 Q2=0.42 //m^3/s
13 printf("\n In SI units , By trial Q= %.2f m^3/s",Q2)

```

Scilab code Exa 4.5 Example 5

```

1 clc
2 //Initialization of variables
3 s=0.86
4 P2=3.8 //psia
5 Patm=26.8 //in of Hg
6 SPatm=29.9 //in of Hg
7 psi=14.7 //psia
8 //calculations
9 Pa=Patm*psi/SPatm
10 Pcrit=-((Pa-P2)*144/(s*62.4))
11 Q=sqrt((-Pcrit+ 10*144/(s*62.4))*64.4*%pi^2
        /(-1/2.25^2 + 1/0.25^2 ))
12 //results
13 printf("Max. theoretical flow = %.1f cfs",Q)

```

Scilab code Exa 4.6 Example 6

```

1 clc
2 //Initialization of variables
3 z=3 //ft
4 s=0.82
5 //calculations
6 ua=sqrt(z*2*32.2)
7 ub=sqrt(2*32.2*(-2*(1-s) +ua^2 /(2*32.2)))
8 //results
9 printf("Velocity at B= %.1f fps",ub)

```

Scilab code Exa 4.7 Example 7

```
1 clc
2 // Initialization of variables
3 d=3 //in
4 x1=0.5^2
5 x2=0.75^2
6 z=80 //ft
7 z3=10 //ft
8 //calculations
9 disp("Using bernoullis theorem")
10 v3=29.7 //fps
11 Q=%pi /4 *(d/12)^2 *v3
12 hls=5*(x1*v3)^2 /(2*32.2)
13 hld=12*(x2*v3)^2 /(2*32.2)
14 //results
15 printf("Head loss in suction pipe = %.1f ft",hls)
16 printf("\n Head loss in discharge pipe = %.1f ft",
    hld)
17 printf("\n Flow rate = %.2f cfs",Q)
```

Scilab code Exa 4.8 Example 8

```
1 clc
2 // Initialization of variables
3 z1=2
4 z2=0.8
5 //calculations
6 disp("From equation of continuity , z1*v1=z2*v2")
7 V1= sqrt((z2-z1)*2*9.81/(1-z1^2 /z2^2))
8 V2=z1*V1/z2
```

```
9 Q=z1*1*V1
10 //results
11 printf("Flow rate = %.2f m^3/s",Q)
```

Scilab code Exa 4.9 Example 9

```
1 clc
2 //Initialization of variables
3 theta=30 //degrees
4 z=10 //ft
5 x=60 //ft
6 //calculations
7 V=sqrt((0.5*32.2*69.3^2)/((x-sind(theta) *69.3)))
8 //results
9 printf("velocity = %.2f fps",V)
```

Scilab code Exa 4.10 Example 10

```
1 clc
2 //Initialization of variables
3 V=60 //fps
4 theta=15 //degrees
5 ra=6/12 //ft
6 rb=8/12 //ft
7 B=1.5/12 //ft
8 //calculations
9 Vra=V*sind(theta)
10 Q=2* %pi*ra*B*Vra
11 Vratio=ra/rb
12 Vb=Vratio*V
13 flow=(V^2 - Vb^2)/(2*32.2)
14 //results
15 printf("Flow rate = %.2f cfs",Q)
```



```
16 printf("\n Velocity at b = %d fps",Vb)
17 printf("\n Pressure head = %.1f ft",flow)
```

Scilab code Exa 4.44 Example 4

```
1 clc
2 // Initialization of variables
3 g=9810 //N/m^3
4 Q=10 //m^3/s
5 H=20 //m
6 // calculations
7 Rate=g*Q*H/1000
8 // results
9 printf("Rate of energy loss = %d kW",Rate-2)
```

Chapter 6

new6

Scilab code Exa 6.1 Example 1

```
1  clc
2  // Initialization of variables
3  g=9.81 //kN/m^3
4  V2=12 //m/s
5  V3=12 //m/s
6  A2=10^2
7  A1=15^2
8  A3=7.5^2
9  t1=15
10 t2=30
11 // calculations
12 V1=(A2*V2 + A3*V3)/A1
13 Q1=%pi /4 *A1*10^-4 *V1
14 Q2=%pi /4 *A2*10^-4 *V2
15 Q3=%pi /4 *A3*10^-4 *V3
16 P1g=V3^2 /(2*g) - V1^2 /(2*g)
17 P1=P1g*g
18 rho=10^3
19 V2x=V2*cosd(t1)
20 V3x=V3*cosd(t2)
21 V1x=V1
```

```

22 Fx= -P1*A1*10^-4 + (rho*Q2*V2x + rho*Q3*V3x - rho*Q1
    *V1x)
23 Fx=Fx*10^-3
24 V2y=V2*sind(t1)
25 V3y=-V3*sind(t2)
26 V1y=0
27 Fy=rho*Q2*V2y +rho*Q3*V3y -rho*Q1*V1y
28 Fy=Fy*10^-3
29 //results
30 printf("Force in x directio = %.3f kN",Fx)
31 printf("\n Force in y direction = %.3f kN",Fy)

```

Scilab code Exa 6.2 Example 2

```

1  clc
2  //Initialization of variables
3  V1x=100 //ft/sec
4  V2x=0.866*95
5  V1y=0
6  V2y=.5*95
7  A1=0.0218 //ft^2
8  //calculations
9  Q=A1*V1x
10 rho=1.94
11 Fx=rho*Q*(V2x-V1x)
12 Fxr=-Fx
13 Fy=rho*Q*(V2y-V1y)
14 //results
15 printf("Horizontal force on the blade = %.1f lb",Fxr
    )
16 printf("\n Vertical force on the blade = %d lb",Fy)

```

Scilab code Exa 6.3 Example 3

```

1  clc
2  // Initialization of variables
3  v2=36 //fps
4  beta=150 //degrees
5  u=60 //fps
6  rho=1.94
7  Qd=0.0218
8  V1=100 //fps
9  gam=62.4
10 g=32.2
11 // calculations
12 v2s=v2*sind(beta)
13 v2c=u+v2*cosd(beta)
14 V2=34 //fps
15 alpha=32 //degrees
16 Fx=rho*Qd*(v2c-V1)*(V1-u)
17 Fy=-rho*Qd*(V1-u)*v2s
18 Fx2=rho*Qd*V1*(v2c-V1)
19 HPin=gam*Qd*V1*(V1^2/(2*g))/550
20 HPout=gam*Qd*V1*(V2^2/(2*g))/550
21 HPtransfer=-Fx2*u/550
22 HPf1=HPin-HPout-HPtransfer
23 // results
24 printf("Force exerted by water on the vane = %d lb",
        Fx2)
25 printf("\\n Friction loss = %.1f hp ",HPf1)

```

Scilab code Exa 6.4 Example 4

```

1  clc
2  // Initialization of variables
3  z1=35 //ft
4  z3=20 //ft
5  P1=30 //psi
6  g=32.2

```

```

7 z2=10 //ft
8 d2=4 //in
9 rho=1.94
10 be=20 //degrees
11 W=150 //lb
12 //calculations
13 V3= sqrt(2*g*(P1*144/55 + z1-z3))
14 Q=3.81 //cfs
15 V2=43.6 //fps
16 P2=55*(z3+ V3^2/(2*g) - z2 - V2^2/(2*g))/144
17 Fx=P2*%pi/4 *d2^2 - rho*55/62.4 *Q*(V3*cosd(be) - V2
    )
18 Fy=rho*55/62.4 *Q*(V3*sind(be) ) + W
19 Fres=sqrt(Fx^2 + Fy^2)
20 Fsx=rho*Q*55/62.4*(V3*cosd(be) )
21 //calculations
22 printf("resultant force = %d lb",Fres)
23 printf("\n horizontal component of force = %d lb",
    Fsx)

```

Scilab code Exa 6.5 Example 5

```

1 clc
2 //Initialization of variables
3 omega=300 //rpm
4 r1=1.6 //ft
5 Q=120 //cfs
6 z=0.8 //ft
7 beta1=80 //degrees
8 r2=1 //ft
9 rho=1.94
10 g=32.2
11 gam=62.4
12 //calculations
13 disp(" part a")

```

```

14 u1=(2*%pi/60)*omega*r1
15 Vr1=Q/(2*%pi*r1*z)
16 v1=Vr1/sind(beta1)
17 v2c=v1*cosd(beta1)
18 V1c=u1+v2c
19 u2=(2*%pi/60)*omega*r2
20 Vr2=Vr1*(r1/r2)
21 beta2=atand(Vr2/u2)
22 printf("required Blade angle = %.1f degrees",180-
    beta2)
23 disp(" part b")
24 T=rho*Q*(r1*V1c)
25 power=T*u2
26 printf("Torque exerted = %d ft lb/s",power)
27 disp(" part c")
28 h2=u1*V1c/g
29 Power=gam*Q*h2
30 printf("Torque exerted = %d ft lb/s",Power)

```

Scilab code Exa 6.6 Example 6

```

1 clc
2 //Initialization of variables
3 V1=150*44/30
4 Q=20000/2
5 d=6.5 //ft
6 rho=0.072
7 //calculations
8 A=%pi/4 *(d)^2
9 V=Q/A
10 dV=2*(V-V1)
11 Ft=rho/32.2 *Q*2*dV
12 eta=1/(1+ dV/(2*V1))
13 dP=Ft/2 /(%pi/4) /d^2
14 hpp=Q*dP/550

```

```
15 //results
16 printf("pressure rise = %d psf",dP)
17 printf("\n horsepower input = %d hp ",hpp)
```

Scilab code Exa 6.7 Example 7

```
1  clc
2  //Initialization of variables
3  V1=8.02 //fps
4  V2=16.04 //fps
5  Q=481 //cfs
6  rho=1.94
7  A=10*6
8  d=3
9  //calculations
10 Fx=62.4*d*A - 62.4*d/2 *A/2 - rho*Q*(V2-V1)
11 V1m=2.56 //m/s
12 V2m=5.12 //m/s
13 Qm=15.4 //m^2/s
14 dm=1
15 Am=2*3
16 rhom=1
17 Fxm=9.81*dm*Am - 9.81*dm/2 *Am/2 - rhom*Qm*(V2m-V1m)
18 //results
19 printf("Force in x- direction = %d lb",Fx)
20 printf("Force in x- direction = %.1f kN",Fxm)
```

Chapter 7

new7

Scilab code Exa 7.2 Example 2

```
1  clc
2  // Initialization of variables
3  Dratio=8
4  mu=0.0006
5  rho=52/32.2
6  vm=1.22*10^-5 //lb s /ft^2
7  V=45 //fps
8  Fm=0.8
9  //calculations
10 vp=mu/rho
11 Vm=vm*V/(Dratio*vp)
12 Fratio=rho*V^2 / (1.94*Vm^2 *Dratio^2)
13 Fp=Fratio*Fm
14 //results
15 printf(" velocity = %.2f fps",Vm)
16 printf(" \n Drag force = %d lb",Fp)
17 disp('The answer given in textbook is wrong. Please
      use a calculator')
```

Scilab code Exa 7.3 Example 3

```
1  clc
2  // Initialization of variables
3  L=50
4  Fm=0.02 //N
5  Vm=1 //m/s
6  // calculations
7  Fp=L^3 *Fm
8  Fp=Fp*0.2248
9  Vp=sqrt(L) *Vm
10 Vp=Vp*3.28
11 Hp=Fp*Vp/550
12 // results
13 printf("Required horsepower = %.1 f hp",Hp)
```

Chapter 8

new8

Scilab code Exa 8.1 Example 1

```
1 clc
2 // Initialization of variables
3 s=0.85
4 nu=1.8*10^-5 //m^2 /s
5 d=10 //cm
6 flow=0.5 //L/s
7 // calculations
8 Q=flow*10^3
9 A=%pi*d^2 /4
10 V=Q/A
11 V=V/10^2
12 R=d*10^-2 *V/nu
13 // results
14 printf("reynolds number = %d .Hence the flow is
    laminar",R)
```

Scilab code Exa 8.2 Example 2

```

1  clc
2  // Initialization of variables
3  Vc=12.7 //cm/s
4  r=2 //cm
5  r2=5 //cm
6  R=354
7  rho=0.85
8  V=6.37 //cm/s
9  D=0.1 //m
10 // calculations
11 k=Vc/r2^2
12 f=64/R
13 T0=f/4 *rho*V^2 /2
14 T02=T0/10
15 hr=f*(V*10^-2)^2 /(2*9.81*D)
16 // results
17 printf(" Friction factor = %.2 f" ,f)
18 printf("\n Shear stress at the pipe wall = %.3 f N/m
    ^2" ,T02)
19 printf("\n Head loss per pipe length = %.5 f m/m" ,hr)

```

Scilab code Exa 8.3 Example 3

```

1  clc
2  // Initialization of variables
3  Q=2
4  A=0.196 //cm^2
5  D=0.5 //ft
6  rho=0.9*1.94
7  mu=0.0008 //lb s/ft^2
8  h1=25
9  g=32.2 //ft/sec^2
10 L=200 //ft
11 r=2 //in
12 // calculations

```

```

13 V=Q/A
14 R=D*V*rho/mu
15 f=h1*D*2*g/(L*V^2)
16 umax=V*(1+1.33*sqrt(f))
17 T0=f*rho*V^2 /8
18 u2=umax - 5.75* sqrt(T0/rho) *log10(D*12/r)
19 //results
20 printf("Center line velocity = %.1f fps",umax)
21 printf("\n Shear stress = %.2f lb/ft^2",T0)
22 printf("\n Velcoity at 2 in from center line = %.2f
    fps",u2)

```

Scilab code Exa 8.4 Example 4

```

1  clc
2  //Initialization of variables
3  f=0.0131
4  d=0.5 //m
5  //calculations
6  V=2.12 //m/s
7  R=10^6
8  Q=%pi*d^2 /4 *V
9  d1=32.8*10^-6 /(V* sqrt(f))
10 //results
11 printf("flow rate = %.3f m^3/s",Q)
12 printf("\n nominal thickness = %.2e m",d1)

```

Scilab code Exa 8.5 Example 5

```

1  clc
2  //Initialization of variables
3  dz=260 //ft
4  ke=0.5

```

```

5 f=0.02
6 l=5000 //ft
7 D=10 //in
8 A2=0.545
9 //calculations
10 V2by2g=dz/(1 + ke + f*l/(D/12))
11 V2=V2by2g*2*32.2
12 V=sqrt(V2)
13 DV=D*V
14 Q=%pi/4 *(D/12)^2 *V
15 //results
16 printf("Flow rate = %.2f cfs",Q)

```

Scilab code Exa 8.6 Example 6

```

1 clc
2 //Initialization of variables
3 z=260 //ft
4 f=0.02
5 //calculations
6 V2by2g=z/(1.11*256 + 6000*f)
7 V2=V2by2g*2*32.2
8 V=sqrt(V2)
9 Q=0.545*V
10 V3=16*V
11 H=z-f*6000*V2by2g
12 //results
13 printf("rate of discharge = %.2f cfs",Q)

```

Scilab code Exa 8.7 Example 7

```

1 clc
2 //Initialization of variables

```

```

3 g=52
4 Hp=2
5 // calculations
6 Q=3.48 // cfs
7 V6=3.48/0.196
8 P=-20.9 // ft
9 P2=P*(g/144)
10 // results
11 printf("Flow rate = %.2f cfs",Q)
12 printf("\n Pressure in the pipe = %.2f psi",P2)

```

Scilab code Exa 8.8 Example 8

```

1 clc
2 // Initialization of variables
3 h=10 //m
4 g=9.81 //m/s^2
5 f1=0.019
6 f2=0.021
7 f3=0.020
8 z1=300 //m
9 z2=150 //m
10 z3=250 //m
11 d1=0.3 //m
12 d2=0.2 //m
13 d3=0.25 //m
14 // calculations
15 disp(" part (a)")
16 Vbyg=h/(f1*z1/d1 +f2*z2/d2 *(d1/d2)^4 + f3*z3/d3 *(
    d1/d3)^4)
17 V1=sqrt(2*g*Vbyg)
18 Q=%pi/4 *d1^2 *V1
19 printf("\n Flow rate = %.3f m^3/s",Q)
20 disp('Part b')
21 Le2=z2*f2/f1 *(d1/d2)^5

```

```

22 Le3=z3*f3/f1 *(d1/d3)^5
23 Le1=z1
24 Le=Le1+Le2+Le3
25 V1byg=h*d1/Le/f1
26 V2=sqrt(2*g*V1byg)
27 Q1=%pi/4 *d1^2 *V2
28 printf("\n Flow rate = %.3f m^3/s",Q1)

```

Scilab code Exa 8.9 Example 9

```

1  clc
2  // Initialization of variables
3  d1=6/12 //ft
4  d2=4/12 //ft
5  d3=8/12 //ft
6  l1=2000 //ft
7  l2=1600 //ft
8  l3=4000 //ft
9  f1=0.020
10 f2=0.032
11 f3=0.024
12 E11=200
13 E12=50
14 E13=120
15 g=32.2
16 //calculations
17 Vc=sqrt(2*g*(E11-E12)/288.9)
18 Qc=%pi/4 *d3^2 *Vc
19 Va=1.346*Vc
20 Qa=%pi/4 *d1^2 *Va
21 Vb=(d3^2 *Vc - d1^2 *Va)/d2^2
22 Qb=%pi/4 *d2^2 *Vb
23 P=62.4/144 *(E11 - E13 - f1*l1/d1 *Va^2 /(2*g))
24 //results
25 printf("Flowrate at A = %.3f cfs",Qa)

```

```
26 printf("\nFlowrate at B = %.3f cfs", Qb)
27 printf("\nFlowrate at C = %.3f cfs", Qc)
28 printf("\nPressure at P = %.2f psi", P)
```

Chapter 9

new9

Scilab code Exa 9.1 Example 1

```
1  clc
2  // Initialization of variables
3  T2=30 //C
4  T1=20 //C
5  cv=716
6  m=15 //kg
7  cp=1003
8  // calculations
9  di=cv*(T2-T1)
10 dU=di*m
11 dh=cp*(T2-T1)
12 dH=dh*m
13 // results
14 printf("Change in Internal energy = %d N m",dU)
15 printf("\n Change in Enthalpy = %d Nm",dH)
```

Scilab code Exa 9.2 Example 2

```

1  clc
2  // Initialization of variables
3  cv=716
4  m=15 //kg
5  cp=1003
6  T1=20+273 //K
7  k=1.4
8  ratio=0.4
9  // calculations
10 T2=(T1)*(1/ratio)^(k-1)
11 P1=95 //kN/m^2
12 P2=P1*T2/(T1)/ratio
13 di=cv*(T2-T1)
14 dU=di*m
15 dh=cp*(T2-T1)
16 dH=dh*m
17 // results
18 printf(" Final temperature = %d K",T2)
19 printf(" \n Final pressure = %d kN/m^2",P2)
20 printf(" \n Change in Internal energy = %d N m",dU)
21 printf(" \n Change in Enthalpy = %d Nm",dH)
22 //The answers are a bit different due to rounding
    off error.

```

Scilab code Exa 9.3 Example 3

```

1  clc
2  // Initialization of variables
3  k=1.4
4  R=1773
5  v=600 //fps
6  T=660 //K
7  P=100 //psia
8  cp=6210
9  g=32.2

```

```

10 // calculations
11 c=sqrt(k*R*T)
12 M=v/c
13 rho=k*P*144/c^2
14 Ps=P*144 + 0.5*(rho)*v^2 *(1+ 0.25*M^2)
15 Ts= (cp/g *T + v^2 /(2*g))*g/cp
16 // results
17 printf("Stagnation pressure = %d lb/ft ^2",Ps)
18 printf("\n Stagnation temperature = %d R",Ts)
19 disp("Please check the units of the answer.")

```

Scilab code Exa 9.4 Example 4

```

1 clc
2 // Initialization of variables
3 g=32.2
4 A=0.0218 // ft ^2
5 P1=25.6 //psia
6 T1=540 //K
7 k=1.4
8 R=1715
9 // calculations
10 G=g*A*P1*144/sqrt(T1) *sqrt(k/R *(2/(k+1)) ^((k+1)/(k
    -1)))
11 // results
12 printf("Flow rate = %.2 f lb/s",G)

```

Scilab code Exa 9.5 Example 5

```

1 clc
2 // Initialization of variables
3 P1=50 //psia
4 T1=540 //K

```

```

5 g=32.2
6 R=1715
7 k=1.4
8 P3=13.5 //psia
9 A2=0.0218 //ft^2
10 cp=6000
11 //calculations
12 Pc=0.528*P1
13 V32=R*T1/g *k/(k-1) *(1- (P3/P1)^((k-1)/k))
14 V3=sqrt(V32*2*g)
15 G3=g*A2*P1*144/sqrt(T1) *sqrt(k/R *(2/(k+1))^((k+1)
    /(k-1)))
16 T3= T1 - V3^2 /(2*cp)
17 gam3= g*P3*144/(R*T3)
18 gam2= (Pc/P3 *gam3^k )^(1/k)
19 V2=G3/gam2/A2
20 T2= (V3^2 -V2^2)/(2*cp) + T3
21 A3=G3/gam3/V3
22 D3= sqrt(4/%pi *A3)
23 G2=G3
24 //results
25 printf("\n velocity at section 3 = %d fps",V3)
26 printf("\n Flow rate at section 3 = %.3f lb/s",G3)
27 printf("\n temperature at section 3 = %d R",T3)
28 printf("\n velocity at section 2 = %d fps",V2)
29 printf("\n Flow rate at section 2 = %.3f lb/s",G2)
30 printf("\n temperature at section 2 = %d R",T2)
31 printf("\n Required Diameter = %.2f in",D3*12)

```

Scilab code Exa 9.6 Example 6

```

1 clc
2 //Initialization of variables
3 P1=10 //psia
4 T1=460+40 //R

```

```

5 R=1715
6 k=1.4
7 V1=1400 //fps
8 //calculations
9 rho1=P1/(R*T1)
10 c1=sqrt(k*R*T1)
11 M1=V1/c1
12 P2= P1 * (2*k*M1^2 - (k-1))/(k+1)
13 V2 =V1*((k-1)*M1^2 +2)/((k+1)*M1^2)
14 rho2=rho1*V1/V2
15 T2=P2/rho2/R
16 P22=122.5
17 V22=286
18 T22=328
19 //results
20 printf("Pressure at point 2 = %.1f psia and %.1f N/m
      ^2", P2, P22)
21 printf("\n Velocity at point 2 = %d fps and %d m/s",
      V2, V22)
22 printf("\n Temperature at point 2 = %d R and %d K",
      T2, T22)
23 disp("Similarly it can be done for SI units")

```

Scilab code Exa 9.7 Example 7

```

1 clc
2 //Initialization of variables
3 A=140 //in^2
4 P=48 //lb/in^2
5 mu=3.78*10^-7
6 g=32.2
7 G=100 //lb/s
8 p=80 //lb/in^2
9 T=65+460 //R
10 k=1.4

```

```

11 R=1715
12 // calculations
13 Rh=A/P /12
14 R1=G*4*Rh/ (mu*g*A/144)
15 R2=R1
16 f=0.0083
17 gam1=p*g*144/(R*T)
18 V1=G*144/gam1/A
19 c=sqrt(k*R*T)
20 M1=V1/c
21 M2=1/sqrt(k)
22 D=4*Rh
23 L= ((1-M1^2 /M2^2)/(k*M1^2) - 2*log(M2/M1) ) *D/f
24 Ln=500 //ft
25 P2=sqrt((p*144)^2 - G^2 *R*T/(g^2 *(A/144)^2 *f*Ln/D
    ))
26 Pa=12.2
27 // results
28 printf("Max. length = %d ft",L)
29 printf("\n Pressure required = %.1f psia",P2/144 -Pa
    )

```

Scilab code Exa 9.8 Example 8

```

1 clc
2 // Initialization of variables
3 G=100 //lb/s
4 g=32.2
5 V2=300 //fps
6 V1=250 //fps
7 // calculations
8 Qh= (V2^2 -V1^2)/(2*g)
9 Q=Qh*G
10 // results
11 printf("Thermal energy added = %d ft lb/s",Q)

```

Scilab code Exa 9.9 Example 9

```
1  clc
2  // Initialization of variables
3  gam1=0.41
4  g=32.2
5  V1=250 // fps
6  R1=8.2*10^6
7  f=0.0083
8  A=0.97 // ft^2
9  G=100 // lb/s
10 k=1.4
11 P=80 // lb/in^2
12 ratio=0.8
13 R=1715
14 // calculations
15 rho1=gam1/g
16 X = G^2 / (gam1*A)^2 + 2*k/(k-1) *(P*144/rho1)
17 P2=(k-1)/2/k *(X*ratio*rho1 - G^2 / (g^2 *A^2 *ratio*
    rho1))
18 L=563 // ft
19 rho2=ratio*rho1
20 V2=G/(rho2*g*A)
21 T2=P2/(rho2*R)
22 // results
23 printf("Length = %d ft",L)
24 printf("\n velocity = %d fps",V2)
25 printf("\n Temperature = %d R",T2)
```

Chapter 10

new10

Scilab code Exa 10.1 Example 1

```
1  clc
2  // Initialization of variables
3  nu=0.001 //ft^2 /s
4  L=1.5 //ft
5  U=2 //ft/s
6  s=0.925
7  ro=1.94
8  b=6
9  //calculations
10 R=L*U/nu
11 Cf=1.328/sqrt(R)
12 Ff=Cf*s*ro*U*b/12 *L
13 delta=4.91 *L/sqrt(R)
14 T0=0.332*nu*s*ro*U/L *sqrt(R)
15 //results
16 printf("Friction drag = %.3f lb",Ff)
17 printf("\n Thickness of boundary layer = %.4f ft",
    delta)
18 printf("\n Shear stress = %.4f lb/ft^2",T0)
19 //Similar calculations are done for SI units case
```

Scilab code Exa 10.2 Example 2

```
1  clc
2  //Initialization of variables
3  nu=0.00015 //ft^2/s
4  L=35 //ft
5  U=88 //fps
6  g=32.2 //ft/s^2
7  b=10 //ft
8  w=8 //ft
9  rho=0.0725
10 //calculations
11 R=L*U/nu
12 Cf=0.455 /(log10(R))^2.58
13 B=2*b + w
14 Ff=Cf*rho/g *U^2 /2 *L*B
15 Rx=R/10^5
16 delta=L*0.377 /(b* Rx^(0.2))
17 T0=0.0587 *rho/g *U^2 /2 *(nu/(L*U))^(0.2)
18 //results
19 printf("Frictional drag = %.1f lb",Ff)
20 printf("\n Thickness of boundary layer = %.3f ft",
    delta)
21 printf("\n Shear stress = %.4f lb/ft^2",T0)
```

Scilab code Exa 10.3 Example 3

```
1  clc
2  //Initialization of variables
3  nu=0.0000166 //ft^2 /s
4  U=5.06 //fps
5  L=50 //ft
```

```

6 g=32.2
7 dia=10 //ft
8 //calculations
9 R=L*U/nu
10 Cf=0.0028
11 Ff=Cf*64/g *U^2 /2 *%pi*dia*L
12 Rx=R/L
13 ec=26*nu/U *Rx^(0.25)
14 Rx2=Rx*L/2
15 T02=0.0587*U^2 /2 /(Rx2)^(0.2)
16 delta2=60*nu/sqrt(T02)
17 //results
18 printf("Friction drag = %d lb",Ff)
19 printf("\n Critical roughness = %.4f ft",ec)
20 printf("\n height of roughness = %.4f ft",delta2)

```

Scilab code Exa 10.4 Example 4

```

1 clc
2 //Initialization of variables
3 Cd=0.45
4 rho=0.0725/32.2
5 V=88 //fps
6 A=8*10
7 //calculations
8 Fd=Cd*rho*V^2 /2 *A
9 Drag2=23
10 D=Fd-Drag2
11 //results
12 printf("Pressure drag = %d lb",D)

```

Scilab code Exa 10.5 Example 5

```

1  clc
2  // Initialization of variables
3  Cd=0.2
4  D=8.5 //in
5  V=412 //fps
6  nu=1.57*10^-4
7  // calculations
8  Vt=480 //fps
9  // results
10 printf("Free fall velocity = %d fps",Vt)

```

Scilab code Exa 10.6 Example 6

```

1  clc
2  // Initialization of variables
3  nu=1.15*10^-5 //m^2/s
4  D=2*10^-3 //m
5  V=15 //m/s
6  T=-20 //C
7  // calculations
8  R=D*V/nu
9  f=0.2 *V/D *(1+T/R)
10 // results
11 printf("Frequency of oscillation = %d Hz",f)

```

Scilab code Exa 10.7 Example 7

```

1  clc
2  // Initialization of variables
3  n=90 //rpm
4  R=2
5  rho=0.0765/32.2
6  B=25

```

```

7 U=120 //fps
8 //calculations
9 vt=2*%pi*R*n/60
10 T=2*%pi*R*vt
11 Fl=rho*B*U*T
12 theta=asind(-T/(4*%pi*R*U))
13 //results
14 printf("Value of circulation = %d ft62/s",T)
15 printf("\n Transverse or lift force = %d lb",Fl)
16 printf("\n Position of stagnation points = %.1f"
,180-theta)

```

Scilab code Exa 10.8 Example 8

```

1 clc
2 //Initialization of variables
3 B=36 //ft
4 c=6 //ft
5 Cl=0.8
6 tau=0.175
7 rho=0.001756
8 V=300 //fps
9 //calculations
10 alphai=Cl/(%pi*B/c) *(1+tau) *180/%pi
11 alpha=5.4
12 lift=-5.6 //degrees
13 alphao=alpha-alphai
14 alphaod=alphao-lift
15 alphaor=alphaod*%pi/180
16 eta=Cl/(2*%pi*alphaor)
17 Fl=Cl*rho*V^2 /2 *B*c
18 Fd=0.047/Cl *13680
19 HP=Fd*V/550
20 //results
21 printf("Friction coefficient = %.3f ",eta)

```

```
22 printf("\n weight of the wing = %d lb",F1)
23 printf("\n Horsepower required = %d hp",HP)
```

Scilab code Exa 10.9 Example 9

```
1  clc
2  // Initialization of variables
3  k=1.4
4  R=287
5  T=249 //K
6  v=600 //m/s
7  d=0.2 //m
8  // calculations
9  c=sqrt(k*R*T)
10 M=v/c
11 Cd=0.62
12 rho=47.22*10^3 /(R*T)
13 Fd=Cd*rho*v^2 /2 *%pi*d^2 /4
14 // results
15 printf(" Drag = %d N",Fd)
```

Chapter 11

new11

Scilab code Exa 11.1 Example 1

```
1 clc
2 // Initialization of variables
3 y=3.4 //ft
4 n=0.016
5 //calculations
6 A=(10+2*y)*y
7 P=10+ 2*sqrt(5) *y
8 Rh=A/P
9 f=116*n^2 /Rh^(1/3)
10 e= 14.8*Rh/ 10^(1/2/sqrt(f))
11 //results
12 printf("absolute roughness of pipe = %.4f ft",e)
```

Scilab code Exa 11.2 Example 2

```
1 clc
2 // Initialization of variables
3 y=1.495 //ft
```

```

4 Q=14 // cfs
5 g=32.2
6 // calculations
7 yc=(Q^2 /g *2)^(1/5)
8 // results
9 printf("yc = %.2f ft is greater than uniform flow
    depth. Hence flow is supercritical",yc)

```

Scilab code Exa 11.3 Example 3

```

1 clc
2 // Initialization of variables
3 q=27/4
4 g=32.2
5 Q=27 // cfs
6 d=2 // ft
7 dz1=0.3 // ft
8 // calculations
9 yc=(q^2 /g)^(1/3)
10 V2=Q/(4*yc)
11 V1=Q/(4*d)
12 dz = d+ V1^2 / (2*g) - V2^2/(2*g) - yc
13 y2=1.6 // ft
14 drop = d-(y2+dz1)
15 dz2=0.6 // ft
16 up=2.12 // ft
17 down=0.66 // ft
18 // results
19 printf("yc = %.2f ft. Since , depth is greater than
    critical depth. the flow is subcritical",yc)
20 printf("\n Drop in water height = %.2f ft",drop)
21 printf("\n Drop upstream = %.2f ft and Downstream =
    %.2f ft",up,down)

```

Scilab code Exa 11.5 Example 5

```
1  clc
2  //Initialization of variables
3  y0=2.17 //ft
4  q=400/10
5  g=32.2
6  d=4.8 //ft
7  S0=0.0016
8  //calculations
9  yc=(q^2 /g)^(1/3)
10 y2=y0/2 *(-1 + sqrt(1+ 8*q^2 /(g*y0^3)))
11 y1=d/2 *(-1 + sqrt(1+ 8*q^2/(g*d^3)))
12 E1=y0 + (q/yc)^2 /(2*g)
13 E2= y1+ (q/y1)^2 /(2*g)
14 Vm=0.5*(q/yc + q/y1)
15 Rm=0.5*(y0/1.434 + y1/1.552)
16 S=(0.013*Vm/(1.49*Rm^(2/3)))^2
17 dx=(E1-E2)/(S-S0)
18 E1d=E2
19 E2d=d+ (q/4.8)^2 /(2*g)
20 HP1=62.4*q*10*(E1d-E2d)/550
21 //results
22 printf("Power loss = %.2f ",HP1)
23 //The answer is a bit different from the textbook
    due to rounding off error
```

Scilab code Exa 11.6 Example 6

```
1  clc
2  //Initialization of variables
3  y1=[1.5 1.48]
```



```
4 V1=[2.22 2.29]
5 d=1.2
6 //calculations
7 q=y1.*V1
8 V2=q/d
9 Vm=[2.5 2.56]
10 Rh1=[0.9 0.89]
11 Rh2=[0.88 0.78]
12 Rhm=(Rh1+Rh2)/2
13 S=(q.*Vm/ Rhm.^(2/3)).^2
14 dx=[358 226]
15 yavg=(y1(1) + y1(2))/2
16 qavg=(q(1) + q(2))/2
17 B=4.5
18 Q=qavg*B
19 //results
20 printf("Flow rate = %.1f m^3/s",Q)
```

Chapter 12

new12

Scilab code Exa 12.1 Example 1

```
1  clc
2  // Initialization of variables
3  P1=10 //psia
4  Q=0.6 //cfs
5  A1=0.0491 //ft^2
6  g=32.2
7  V=39.2//fps
8  A0=0.0218 //ft^2
9  d1=2 //in
10 d2=3 //in
11 //calculations
12 Phead=P1*144/62.4
13 V1=Q/A1
14 V2i= sqrt(2*g*(Phead + V1^2 /(2*g)))
15 Cv=V/V2i
16 A2=Q/V
17 Cc=A2/A0
18 Cd=Cc*Cv
19 hL=(1/Cv^2 -1)*(1- (d1/d2)^4)*V^2 /(2*g)
20 //results
21 printf("Cc = %.2 f ",Cc)
```

```
22 printf("\n Cd= %.2 f",Cd)
23 printf("\n Cv= %.2 f",Cv)
24 printf("\n Head loss = %.2 f ft",hL)
```

Scilab code Exa 12.2 Example 2

```
1 clc
2 // Initialization of variables
3 d=2 //in
4 g=32.2
5 d1=3 //in
6 k=1.06
7 // calculations
8 A2=%pi/4 *d^2 /144
9 dp=d/12
10 Q=k*A2*sqrt(2*g*dp)
11 A=%pi/4 *(d1/12)^2
12 V1=Q/A
13 K2=1.04
14 Q2=K2/k *Q
15 // results
16 printf("Flow rate = %.4 f cfs",Q2)
```

Scilab code Exa 12.3 Example 3

```
1 clc
2 // Initialization of variables
3 P1=700 //kN/m^2
4 P2=400 //kN/m^2
5 D2=12.5 //cm
6 D1=25 //cm
7 C=0.985
8 g=9.81
```

```

9 R=287 //m^2/s^2 K
10 T=273+20 //K
11 //calculations
12 Pr=P2/P1
13 Dr=D2/D1
14 Y=0.72
15 gam1=P1*g/(R*T)
16 G=C*Y*pi/4 *(D2/100)^2 *sqrt(2*g*gam1*(P1-P2)/(1-
    Dr^4))
17 //results
18 printf("Weight flow rate = %.4f kN/s",G)

```

Scilab code Exa 12.4 Example 4

```

1 clc
2 //Initialization of variables
3 V=3 //fps
4 y=1 //ft
5 L=4 //ft
6 //calculations
7 H= (V*y/3.33)^(2/3)
8 P=L-H
9 //results
10 printf("Height of weir = %.2f ft",P)

```

Chapter 13

new13

Scilab code Exa 13.1 Example 1

```
1  clc
2  // Initialization of variables
3  ken=0.5
4  kex=0.2
5  f=0.0018
6  l=10 //ft
7  dia=3 //in
8  z1=8
9  z2=5
10 //calculations
11 x1=ken+kex+f*l*12/dia
12 t=35.5*2/3 *(z1^(3/2) - z2^(3/2))
13 //results
14 printf("Time required = %d s",t)
```

Scilab code Exa 13.2 Example 2

```
1  clc
```

```

2 //Initialization of variables
3 disp("For steady state , dV/dt =0")
4 Q=1600/449
5 A2=0.1963
6 g=32.2
7 rp2=2000
8 //calculations
9 V2=Q/A2
10 hp1=32*V2^2 /(2*g) -50
11 hp2=hp1*(rp2/1650)^2
12 hpf=169 //ft
13 Q=4.1 //cfs
14 //results
15 printf("Steady state flow rate = %.2f cfs",Q)

```

Scilab code Exa 13.3 Example 3

```

1 clc
2 //Initialization of variables
3 k1=0.5
4 f=0.02
5 L=15 //ft
6 D=0.1 //ft
7 k=3.5
8 g=9.81
9 H=2//ft
10 //calculations
11 k=k1+f*L/D
12 V0=sqrt(2*g*H/(1+k))
13 Q=[0.25 0.5 0.75]
14 V=V0*Q
15 Vfun=(2.95+V) ./ (2.95-V)
16 lnVfun=log(Vfun)
17 t=1.129*lnVfun
18 //results

```

```
19 disp(t)
20 disp(" Similarly , it can be calculated for L=150,1500
      ft")
```

Scilab code Exa 13.4 Example 4

```
1  clc
2  // Initialization of variables
3  Q=30 // cfs
4  r=2 //ft
5  cp=3200
6  rho=1.94
7  Q2=10 // cfs
8  z=300 //ft
9  // calculations
10 V=Q/(%pi*r^2)
11 ph=rho*cp*V/144
12 phd=4000/cp /(2*r) *ph
13 dV=(Q2-Q)/(%pi*r^2)
14 dph=-rho*cp*dV/144
15 ph3=rho*cp*V/3 /144
16 ph4=ph3*z*2/cp
17 // results
18 printf(" Water hammer pressure= %.1f psi",ph)
19 printf("\n Water hammer pressure in case 2= %.1f psi
      ",phd)
20 printf("\n Water hammer pressure in case 3= %.1f psi
      ",dph)
21 printf("\n Pressure at valve in case 4 = %.1f psi",
      ph3)
22 printf("\n Pressure at 300 ft from reservoir = %.2f
      psi",ph4)
```

Chapter 14

new14

Scilab code Exa 14.1.a Example 1

```
1 clc
2 // Initialization of variables
3 g=9.81 //kN/m^3
4 Q=3.2 //m^3/s
5 h=25 //m
6 eta=0.82
7 // calculations
8 bp= g*Q*h/eta
9 // results
10 printf(" Brake power = %d kW" ,bp)
```

Scilab code Exa 14.1.b Example 2

```
1 clc
2 // Initialization of variables
3 D1=50
4 n1=1450
5 n2=1200
```



```

6 D2=80
7 Q1=3.2 // cfs
8 h1=25 //m
9 g=9.81 //kN/m^3
10 eta=0.82
11 // calculations
12 h2=h1*(D2/D1)^2 *(n2/n1)^2
13 Q2=Q1*(D2/D1)^3 *(n2/n1)
14 bp=g*Q2*h2/eta
15 h1=82 // ft
16 Q1=50700 //gpm
17 h2=143.8 // ft
18 Q2=171800 //gpm
19 Ns1=n1*sqrt(Q1) /h1^(3/4)
20 Ns2=n2*sqrt(Q2) /h2^(3/4)
21 // results
22 printf(" Brake power = %d kW",bp)
23 printf("\n Pumps are homologous. We expect them to
    have same specific speed and their speeds are %.1
    f and %.1f",Ns1,Ns2)
24 disp(" 14.1c is included in this example itself")

```

Chapter 15

new15

Scilab code Exa 15.1 Example 1

```
1  clc
2  // Initialization of variables
3  z2=500//ft
4  z1=300//ft
5  D=[1 1.5 2 2.5 3 4 6]
6  g=32.2
7  gam=62.4
8  // calculations
9  Dj=D/12
10 Vj=sqrt((z2-z1)*2*g./(1.04 + 640.*Dj.^4))
11 Aj=%pi/4 *Dj.^2
12 Q=Aj.*Vj
13 Pjet=gam*Q.*Vj.^2 /(2*g) /550
14 Pj=max(Pjet)
15 for i=1:length(Pjet)
16     if(Pjet(i) ==Pj)
17         break
18     end
19 end
20 diameter=D(i)
21 // results
```

```
22 printf("Thus a pipe of %d in will be the optimum",
    diameter)
```

Scilab code Exa 15.2 Example 2

```
1  clc
2  //Initialization of variables
3  phi=0.46
4  g=32.2
5  k=0.44
6  cv=0.98
7  d=10 //in
8  A=0.545 //ft^2
9  beta=160 //degrees
10 //calculations
11 u=phi*sqrt(2*g)
12 V1=cv*sqrt(2*g)
13 gQ=62.4*A*V1
14 T=d/2 *gQ/g *(1 -cosd(beta) /sqrt(1+k) )*sqrt(2*g)*(
    cv-phi)
15 Power=T*2*u/d
16 //results
17 printf("Torque required = %d ft lb",T)
18 printf("\n Power transferred = %d ft lb/s",Power)
19 Pi=gQ
20 He=Power/Pi
21 printf("\n Hydraulic efficiency = %.2f",He)
22 v1=V1-u
23 v2=v1/(sqrt(1+k))
24 hl=k*v2^2 /(2*g)
25 printf("Head loss in bucket friction = %.4f",hl*100)
26 Hn=(1/cv^2 -1)*V1^2 /(2*g)
27 printf("\n Head loss in nozzle = %.4f",Hn*100)
28 V2cos=u+v2*cosd(beta)
29 V2sin=v2*sind(beta)
```

```

30 alpha=acot(V2cos/V2sin)
31 V2=V2sin/sin(alpha)
32 Hd=V2^2/(2*g)
33 printf("\n Head loss at discharge = %.2f",Hd*100)
34 Htotal=Hd+Hn+h1
35 printf("\n Total head loss = %.2f",Htotal*100)

```

Scilab code Exa 15.3.a Example 3

```

1  clc
2  // Initialization of variables
3  cv=0.98
4  g=32.2
5  h=1320 //ft
6  A=0.196 //ft^2
7  eta=0.85
8  ne=400
9  phi=0.45
10 // calculations
11 V=cv*sqrt(2*g*h)
12 Q=A*V
13 bhp=eta*62.4*Q*h/550
14 ns=ne*sqrt(bhp) /h^(5/4)
15 u=phi*sqrt(2*g*h)
16 D=u*60/%pi/ne
17 // results
18 printf("Pitch diameter = %.2f ft",D)

```

Scilab code Exa 15.3.b Example 4

```

1  clc
2  // Initialization of variables
3  cv=0.98

```

```

4 g=32.2
5 h=1320 //ft
6 A=0.196 //ft^2
7 eta=0.85
8 ne=400
9 phi=0.45
10 //calculations
11 V=cv*sqrt(2*g*h)
12 Q=A*V/3
13 bhp=eta*62.4*Q*h/550
14 ne2=600
15 ns1=ne2*sqrt(bhp) /h^(5/4)
16 D=2500/ne2
17 Dj=sqrt(Q*4/V/%pi)
18 //results
19 printf("Jet diameter = %.3f ft",Dj)
20 printf("\n Specific speed = %.2f ",ns1)
21 printf("\n Pitch Diameter = %.2f ft",D)
22 printf("\n Operating speed = %d rpm",ne2)

```

Chapter 16

new16

Scilab code Exa 16.2 Example 2

```
1  clc
2  // Initialization of variables
3  ns=20
4  eta=0.925
5  etah=0.94
6  BD=0.1
7  phie=0.72
8  g=32.2
9  alpha2=90 //degrees
10 //calculations
11 Cr=ns^2 /(67100*phie^2 *BD*eta)
12 c1cos=etah/(2*phie)
13 alpha=atan(Cr/c1cos)
14 C1=Cr/sin(alpha)
15 beta1=acotd((C1*cos(alpha) -phie)/(C1*sin(alpha)))
16 //results
17 printf("Alpha = %.2f degrees",alpha*180/%pi)
18 printf("\n Beta = %.2f degrees",beta1)
19 disp("part b")
20 h=402
21 n=600 //rpm
```

```

22 bhp=3600
23 ns=n*sqrt(bhp) /h^(5/4)
24 D=153.2*phie*sqrt(h) /n
25 B=BD*D
26 Dt=D*0.735
27 Ac=0.95*%pi*D*B
28 Vr=Cr*sqrt(2*g*h)
29 Q=Ac*Vr
30 //results
31 printf("\n Breadth= %.3f ft",B)
32 printf("\n depth D= %.3f ft",D)
33 printf("\n velocity Vr= %d ft/s",Vr)
34 printf("\n Flow rate Q= %.1f cfs",Q)

```

Scilab code Exa 16.3 Example 3

```

1 clc
2 //Initialization of variables
3 ns=70
4 z1=10 //ft
5 z2=5000 //ft
6 //calculations
7 P1=12.2*144/62.4
8 P2=0.26*144/62.4
9 sigmac=0.31
10 h=(P1-P2-z1)/sigmac
11 //results
12 printf("Max permissible head to assure against
    cavitation = %d ft",h)

```

Scilab code Exa 16.4 Example 4

```

1 clc

```

```
2 //Initialization of variables
3 Q=600 //cfs
4 z=350 //ft
5 eta=0.9
6 //calculations
7 power=62.4*Q*z*eta/550
8 rpm=75
9 n=2
10 ns=rpm*sqrt(power/n) /z^(5/4)
11 phi=0.45
12 D=153.3*sqrt(z) *phi/rpm
13 rpm2=600
14 ns2=rpm2*sqrt(power/n) /z^(5/4)
15 //results
16 printf("For two turbines , ns= %.2 f",ns)
17 printf("\n For francis turbines , ns= %d ",ns2)
```

Chapter 17

new17

Scilab code Exa 17.1.b Example 2

```
1 clc
2 // Initialization of variables
3 ne=600
4 gpm=1600
5 Ns=500
6 Head=900 //ft
7 // calculations
8 h=(ne*sqrt(gpm) /Ns)^(4/3)
9 n=Head/h
10 // results
11 printf("No. of stages = %d",n+1)
```

Scilab code Exa 17.1 Example 1

```
1 clc
2 // Initialization of variables
3 Ns=500
4 h=900 //ft
```

```

5 Q=1600 //gpm
6 //calculations
7 ne=Ns*h^(3/4) /sqrt(Q)
8 //results
9 printf("Minimum rotative speed = %d rpm",ne)

```

Scilab code Exa 17.2 Example 3

```

1 clc
2 //Initialization of variables
3 ne=600
4 gpm=2000
5 h=150
6 num=2
7 //calculations
8 ns=ne*sqrt(gpm) /h^(3/4)
9 gpm2=num*gpm
10 h2=num^2 *h
11 Ns=2*ne*sqrt(gpm2) /h2^(3/4)
12 Ne2=Ns*(h/2)^(3/4) /sqrt(gpm)
13 //results
14 printf("Specific speed in case1 = %d ",ns)
15 printf("\nFlow rate in case 2 = %d gpm",gpm2)
16 printf("\n Head in case 2 = %d ft",h2)
17 printf("\n Specific speed in case 2 = %d ",Ns)
18 printf("\n required operating speed in case 2 = %d
rpm",Ne2)

```

Scilab code Exa 17.3 Example 4

```

1 clc
2 //Initialization of variables
3 ne=600/2

```

```

4 gpm=1450
5 h=140
6 NPSH=10.4
7 //calculations
8 Ns=gpm*sqrt(ne) /h^(3/4)
9 sigmac=NPSH/h
10 zsmax=-3 //ft
11 //results
12 printf("Sigma C for the pump = %.4f",sigmac)
13 printf("\n Position of pump = %d ft",zsmax)

```

Scilab code Exa 17.4 Example 5

```

1 clc
2 //Initialization of variables
3 ne=600
4 gpm=84500
5 h=225
6 f=0.95
7 phie=1.1
8 g=32.2
9 //calculations
10 Ns=ne*sqrt(gpm) /h^(3/4)
11 u2=phie*sqrt(2*g*h)
12 D=153.2*phie*sqrt(h) /ne
13 D0=1.06*D*12 //in
14 B=0.155*D0*12 //in
15 De=0.6*D0
16 u0=1.06*u2
17 Vm2=0.15*u0
18 Area=0.95*%pi*D/144 *B
19 Q=Area*Vm2
20 //results
21 printf(" Specific speed =%d ",Ns)
22 printf("\n Flow rate = %d cfs",Q)

```

```
23 printf("\n Eye diameter = %.1f in",De)
```
