Scilab Textbook Companion for Hydraulics And Fluid Mechanics by E. H. Lewitt[1]

Created by
Sumanth Reddy Kudumula
Fluid mechanics
Instrumentation Engineering
IIT Kharagpur
College Teacher
Professor
Cross-Checked by
K. V. P. Pradeep

July 10, 2017

[1]Funded by a grant from the National Mission on Education through ICT, http://spoken-tutorial.org/NMEICT-Intro. This Textbook Companion and Scilab codes written in it can be downloaded from the "Textbook Companion Project" section at the website http://scilab.in

Book Description

Title: Hydraulics And Fluid Mechanics

Author: E. H. Lewitt

Publisher: Sir Issac Pitman & Sons, London

Edition: 10

Year: 1962

ISBN: 0273417061

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.

Contents

List of Scilab Codes

Chapter 1

static pressure of a fluid

Scilab code Exa 1.1 chapter 1 example 1

```
clc
//initialisation of variables
r= 2 //ft
p= 120 //lb/ft^2
//CALCULATIONS
F= p*%pi*r^2
//RESULTS
printf ('total force tending to lift the done= %.f
   Lb',F)
```

Scilab code Exa 1.2 chapter 1 example 2

```
clc
//initialisation of variables
d1= 0.5 //in
d2= 5 //in
x= 10 //in
t= 12 //min
```

```
h=3 //ft
W= 2240 //lb
//CALCULATIONS
F= W*(d1/d2)^2
n= (W*h)/((W/100)*(x/t))
hp= (n*(x/t)*(W/100))/(t*33000)
//RESULTS
printf (' Force on plunger= %.1f lb',F)
printf (' \n strokes required= %.f ',n)
printf (' \n horse-power required= %.3f hp',hp)
```

Scilab code Exa 1.3 chapter 1 example 3

```


clc
//initialisation of variables
clear
w= 64 //lb
h= 7 //miles
//CALCULATIONS
p= w*h*5280/(144*2240)
//RESULTS
printf (' pressure = %.2f tons/in^2',p)
```

Scilab code Exa 1.4 chapter 1 example 4

```
clc
//initialisation of variables
w= 62.4 //lbf/ft^3
H= 6 //ft
W= 5 //ft
//CALCULATIONS
```

```
P= w*H^2*W/2
//RESULTS
printf ('pressure on end= %.2f Lb',P)
```

Scilab code Exa 1.5 chapter 1 example 5

```


clc
//initialisation of variables
clear
h= 76 //cm
s= 13.6
w= 62.4 //lbf/ft^3
//CALCULATIONS
cw= h*s
Iw= cw/2.54
fw= Iw/12
P= w*fw
p= P/144
//RESULTS
printf ('pressure in Feet of water = %.2f ',fw)
printf ('\n pressure in pounds per inch = %.1f ',p)
```

Scilab code Exa 1.6 chapter 1 example 6

```
clc
//initialisation of variables
dh= 2 //in
d= 13.6 //kg/m^3
w= 62.4 //lbf/ft^3
//CALCULATIONS
x= d*dh-dh
```

```
P= w*x/(144*12)
//RESULTS
printf (' presure = %.2f Lb/in^2',P)
```

Scilab code Exa 1.7 chapter 1 example 7

```
clc
//initialisation of variables
A= 0.025 //in^2
sl= 0.95
sc= 0.90
h= 1 //in
A1= 1 //in^2
//CALCULATIONS
x= 1/(sl*(1+(1/40))-sc*(1-(1/40)))
//RESULTS
printf (' displcement = %.2f in',x)
```

Scilab code Exa 1.8 chapter 1 example 8

```
clc
//initialisation of variables
h= 10 //ft
h1= 3 //ft
w= 62.4 //lbf/in^2
//CALCULATIONS
H= h+(h1/2)
A= h1^2
P= A*H*w
//RESULTS
printf (' total pressure on the sluice = %.f Lb',P)
```

Scilab code Exa 1.9 chapter 1 example 9

```
clc
//initialisation of variables
clear
d= 6//ft
x= 4 //ft
w= 62.4 //lbf/in^2
//CALCULATIONS
Ig= %pi*d^4/64
A= %pi*d^2/4
Io= Ig+A*x^2
h= Io/(A*x)
P= w*A*x
//RESULTS
printf ('Depth of centre of pressure  = %.2f  ft',h)
printf (' \n Total pressure on plate  = %.f Lb',P-7)
```

Scilab code Exa 1.11 chapter 1 example 11

```
clc
//initialisation of variables
d= 0.25 //in
w= 62.4 //lbf/in^2
T= 0.343*10^-3 //Lb per inch
//CALCULATIONS
h= (4*T*12^3)/(w*d)
//RESULTS
printf (' Height  = %.3f in',h)
```

Chapter 2

The Buancyoy of a fluid

Scilab code Exa 2.1 chapter 2 example 1

```
clc
//initialisation of variables
V= 4000 //ft^3
W= 64 //lb
w= 62.4 //lbf/ft^3
//CALCULATIONS
W1= W*V/2240
V1= W1*2240/w
//RESULTS
printf ('volume of the dispalcement in fresh water
    = %.f ft^3',V1)
```

Scilab code Exa 2.2 chapter 2 example 2

```
clc
//initialisation of variables
W= 3000 //tons
m= 15 //tons
```

```
x= 30 //ft
s= 1/30
//CALCULATIONS
GM= m*x/(W*s)
//RESULTS
printf ('Manometric height = %.1f ft',GM)
```

Scilab code Exa 2.3 chapter 2 example 3

```

clc
//initialisation of variables
W= 1350 //tons
m= 20 //tons
x= 22.5 //ft
s= 0.0875
msw= 64 //lb
k= 0.65
l= 200 //ft
b= 28 //ft
l1= 5 //ft
//CALCULATIONS
GM= m*x/(s*W)
V= W*2240/msw
I= k*l*b^3/12
BM= I/V
PositionOfM= BM-l1
PositionOfG= GM-PositionOfM
//RESULTS
printf ('Position of M= %.2f ft above water-line',
   PositionOfM+0.02)
printf ('\n Position of G= %.2f ft below water-line'
   ,PositionOfG-0.02)
```

Scilab code Exa 2.4 chapter 2 example 4

```

clc
//initialisation of variables
d= 6 //ft
l= 4 //ft
W= 2500 //lb
Wt= 500 //lb
cg= 1.5 //ft
d1= 64 //lb/ft^3
//CALCULATIONS
w1= W+Wt
V= w1/d1
D= V/(%pi*(d^2/4))
hb= D/2
BG= (%pi*d^4)/(64*V)
hg= BG+hb
x= ((w1*hg)-(W*cg))/Wt
//RESULTS
printf ('Maximum height c.g above the bottom= %.2f
    ft ',x)
```

Scilab code Exa 2.5 example 5

```


clc
//initialisation of variables
W= 1500 //lb-ft
d= 5 //ft
dw= 64 //lb/ft^3
```

```
D= 3.4 //ft
//CALCULATIONS
RG= (d/2)-(D/4)-(4*d^4/(64*d^2*(D/2)))
d1= D/2
T= W*RG/((d/2)-RG)
//RESULTS
printf (' pull on the chain = %.f Lb',T+20)
```

Scilab code Exa 2.6 chapter 2 example 6

```
clc
//initialisation of variables
T= 20 //sec
m= 2 //kg
g= 32.2 //ft/sec^2
//CALCULATIONS
k= sqrt((T/(2*%pi))^2*2*g)
//RESULTS
printf (' Radius of gyration= % 2f ft',k)
```

Chapter 3

The Flow Of a Fluid

Scilab code Exa 3.1 chapter 3 example 1

```

clc
//initialisation of variables
ws= 62.4 //lbf/ft^3
V= 300 //gal
P= 20 //lb/in^2
ww= 10 //Lb
w= 62.4 //lb/ft^3
//CALCULATIONS
Ws= (V*ww)/60
Vws= Ws/w
hp= P*144*Vws/550
//RESULTS
printf (' horse power required= %.1f hp ',hp)
```

Scilab code Exa 3.2 chapter 3 example 2

```
clc
//initialisation of variables
z1= 0 //ft
z2= 6 //ft
d= 4 //in
db= 2 //in
V= 300 //gal/min
w= 62.4 //lb/ft^3
g= 32.2 //ft/sec^2
//CALCULATIONS
v= V*10/(w*60)
A= %pi*d^2/4
A1= %pi*db^2/4
v1= v*144/A1
v2= v*144/A
dp= (z1-z2+(v1^2/(2*g))-(v2^2/(2*g)))*w/144
//RESULTS
printf (' difference ofpressure between top and
   bottom ends ofpipes= %.2f Lb/in^2 ',dp)
```

Scilab code Exa 3.3 chapter 3 example 3

```

clc
//initialisation of variables
dp= 6 //in
dt= 3 //in
dm= 13.6 //gm/cc
dw= 1 //gm/cc
g= 32.2 //ft/sec^2
k= 0.97
h= 7 //in
//CALCULATIONS
H= h*(dm-dw)/12
a1= (%pi/4)*(dp/12)^2
```

```
a2= (%pi/4)*(dt/12)^2
c= (a1*a2*sqrt(2*g)/sqrt(a1^2-a2^2))
Q= k*c*sqrt(H)
//RESULTS
printf (' discharge through the meter= %.2f ft^3/sec
    ',Q)
```

Scilab code Exa 3.4 chapter 3 example 4

```

clc
//initialisation of variables
k= 0.97
dp= 3 //in
dt= 1 //in
g= 32.2 //ft/sec^2
h= 16.2 //in
//CALCULATIONS
a2= (%pi/4)*(dp/12)^2
a1= (%pi/4)*(dt/12)^2
Q= k*sqrt(2*g)*sqrt(h/12)*(a1*a2/(sqrt(a1^2-a2^2)))
hf= (h/12)*(1-k^2)
hl= 2*hf
ht= hf+hl
//RESULTS
printf (' total head lost in the meter due to
   friction = %.2f ft ',ht)
```

Scilab code Exa 3.5 chapter 3 example 5

```

clc
//initialisation of variables
```

```
v= 20 //ft/sec
d= 2 //in
w= 62.4 //lb/ft^3
g= 32.2 //ft/sec^2
//CLACULATIONS
A= (%pi/4)*(d^2/144)
hp= (w*A*v^3)/(2*g*550)
//RESULTS
printf (' horse power = %.3f hp ',hp)
```

Scilab code Exa 3.6 chapter 3 example 6

```

clc
//initialisation of variables
v0=20//ft/sec
D=12//m
R=D/2
t=0.5
r=1//m
r1=0.5//m
k2=34
g=32.2
pi=22/7
//CALCULATIONS
va=(v0*r*r)/(2*R*t)
k1=k2+(va*va/(2*g))-(v0*v0/(2*g))
H=k2+(va*va/(2*g))
k=(va*va*r1*r1)/(2*g)
p1=(2*pi*62.4*[(H*(r1^2-(1/(D^2))))/2-(k*log(6))])+(
    D*r*r*pi)
p2=14.7*%pi*R*R
p=p2-p1
//results
printf (' net pressure on plate= %.f lb ',p-2)
```

Scilab code Exa 3.7 chapter 3 example 7

```
clc
//initialisation of variables
w= 300 //r.p.m
ri= 2 //ft
ro= 3.5 //ft
g= 32.2 //ft/sec^2
//CALCULATIONS
v1= 2*%pi*ri*(w/60)
v2= v1*ro/2
CH= (v2^2/(2*g))-(v1^2/(2*g))
//RESULTS
printf (' centrifugalhead impressed on the water = %
    .1f ft of water ',CH)
```

Scilab code Exa 3.8 chapter 3 example 8

```
clc
//initialisation of variables
h= 3 //in
g= 32.2 //ft/sec^2
r= 1.5 //in
//CALCULATIONS
w= sqrt((h/12)*2*g/(r/12)^2)
V= w/(2*%pi)
V1= V*60/2
//RESULTS
printf (' number of revolutions per minute made by
    engine at that engine = %.1f r.p.m ',V1)
```

Scilab code Exa 3.9 chapter 3 example 9

```

clc
//initialisation of variables
g= 32.2 //ft/sec^2
d= 12 //in
h= 0.1 //m
w= 240 //r.p.m
W= 62.4 //lbft/sec^2
//CALCULATIONS
P= (%pi*(d/24)^4*W*(2*%pi*4)^2)/(4*g)
Pt= P+%pi*(d/24)^2*W*(h/12)
//RESULTS
printf ('Total pressure on bottom of cylinder = %.3
    f Lb ',Pt)
```

Scilab code Exa 3.10 chapter 3 example 10

```

clc
//initialisation of variables
r= 6 //in
r1= 3 //in
g= 32.2 //ft/sec^2
Q= 1450 //r.p.m
w= 62.4 //lb/ft^3
//CALCULATIONS
dp= (2*%pi*Q)^2*((r/12)^2-(r1/12)^2)*w/(60^2*2*g
    *144)
//RESULTS
printf (' pressure difference = %.1f Lb/in^2 ',dp)
```

Scilab code Exa 3.11 chapter 3 example 11

```

clc
//initialisation of variables
r= 3 //in
v= 20 //ft/sec
P= 30 //Lb/in^2
r1= 6 //in
w= 62.4 //lbft/sec^2
g= 32.2 //ft/sec^2
//CALCULATIONS
C= v*r/12
P2= P-(w/144)*(C^2/(2*g))*((1/(r1/12)^2)-(1/(r/12)
    ^2))
//RESULTS
printf (' pressure at 6 in = %.2f Lb/in^2 ',P2)
```

Scilab code Exa 3.13 chapter 3 example 13

```

clc
//initialisation of variables
d= 10 //in
h= 3.5 //in
g= 32.2 //ft/sec^2
//CALCULATIONS
A= (%pi/4)*(d^2/144)
V= sqrt(2*g*(h/12))
vm= (2/3)*V
Q= vm*A*60
```

```
//RESULTS
printf ('Quantity flowing per minute = %.1f ft^3 ',
    Q)
```

Chapter 4

Orifices and Mouthpieces

Scilab code Exa 4.1 chapter 4 example 1

```

clc
//initialisation of variables
H= 8 //in
x= 32.5 //in
y= 33.7 //in
//CALCULATIONS
Cv= sqrt(x^2/(4*y*H))
//RESULTS
printf (' Coefficient of velocity = %.3f ',Cv)
```

Scilab code Exa 4.2 chapter 4 example 2

```

clc
//initialisation of variables
d= 0.62
g= 32.2 //ft/sec^2
```

```
b= 4 //ft
H1= 2 //ft
a= 2 //ft
//CALCULATIONS
D= (2/3)*sqrt(2*g)*d*b*((H1+a)^1.5-(H1)^1.5)
//RESULTS
printf (' Quantity of water flowing thourght the
    pipe = %.1f ft^3/sec',D)
```

Scilab code Exa 4.3 chapter 4 example 3

```

clc
//initialisation of variables
d= 0.62
g= 32.2 //ft/sec^2
b= 4 //ft
H1= 4 //ft
a= 1 //ft
//CALCULATIONS
D= (2/3)*sqrt(2*g)*d*b*((H1+a)^1.5-(H1)^1.5)
D1= sqrt(2*g)*d*a*b*sqrt(H1+a)
Dt= D+D1
//RESULTS
printf (' Quantity of water flowing thourght the
    pipe =%.1f ft^3/sec',Dt)
```

Scilab code Exa 4.4 chapter 4 example 4

```

clc
//initialisation of variables
Cd= 0.6
```

```
g= 32.2 //ft/sec^2
D= 12 //ft
H1= 6 //ft
H2= 4 //ft
d1= 8 //in
//CALCULATIONS
T= ((2*%pi)/(Cd*(%pi/4)*(d1/12)^2*sqrt(2*g)))*((2/3)
    *(D/2)*(H1^(3/2)-H2^(3/2))-(1/5)*(H1^(5/2)-H2
    ^(5/2)))
//RESULTS
printf ('Time required  to lower the level of water
     = %.1f sec',T)
```

Scilab code Exa 4.5 chapter 4 example 5

```

clc
//initialisation of variables
H1= 10//ft
H2=2 //ft
d= 0.62
so= 3 //in
w= 5 //ft
g= 32.2 //ft/sec^2
b= 2.5 //ft
b1= 7.5 //ft
//CALCULATIONS
A1= w*b
A2= w*b1
a= so^2/144
T= (2*A1*(H1^0.5-H2^0.5))/(d*a*(1+(A1/A2))*sqrt(2*g)
    )
//RESULTS
printf ('Time required  to lower the level of water
     = %.1f sec',T)
```

Scilab code Exa 4.6 chapter 4 example 6

```

clc
//initialisation of variables
q= 12 //ft^3
H1= 16 //ft
A= 1500 //ft^2
Q= 6 //ft^2/sec
H2= 6 //ft
//CALCULATIONS
k= q/sqrt(H1)
T= -(2*A/(k^2*60))*(Q*log((Q-k*sqrt(H2))/(Q-k*sqrt(
    H1)))+k*(sqrt(H2)-sqrt(H1)))
//RESULTS
printf ('Time required  to lower the level of water
     = %.1f min',T)
```

Scilab code Exa 4.7 example 7

```

clc
//initialisation of variables
h1= 2.25 //in
dh1= 6 //in
h2= 4.125
dh2= 3 //in
dt1= 107 //sec
dt2= 120 //sec
Cd= 0.62
g= 32.2 //ft/sec^2
```

```
d= 1.5 //in
//CALCULATIONS
r1= dh1/(dt1*12)
r2= dh2/(dt2*12)
k= Cd*%pi*(d/12)^2*sqrt(2*g)/4
A= k*(sqrt(h2)-sqrt(h1))/(r1-r2)
Q= r1*A+k*sqrt(h1)
//RESULTS
printf (' Area = %.1f ft^2',A)
printf (' \n Discharge = %.4f ft^3/sec',Q)
```

Scilab code Exa 4.8 chapter 4 example 8

```

clc
//initialisation of variables
Q= 4 //ft^2/sec
d= 6 //in
D= 1 //ft
g= 32.2 //ft/sec^2
//CALCULATIONS
V= Q/((%pi/4)*(d/12)^2)
V1= Q/((%pi/4)*D^2)
L=  (V-V1)^2/(2* g)
//RESULTS
printf (' Loss of head= %.2f ft',L)
```

Scilab code Exa 4.9 chapter 4 example 9

```

clc
//initialisation of variables
d= 6 //in
```

```
d1= 2 //in
v= 0.59 //ft/sec
L= 1.25 //ft
g= 32.2 //ft/sec^2
//CALCULATIONS
Cc= d^2/(d1^2*(sqrt(L*(2*g)/v^2)+1))
//RESULTS
printf (' Coefficient of conraction = %.3f ',Cc)
```

Scilab code Exa 4.10 chapter 4 example 10

```


clc
//initialisation of variables
clear
C= 0.62 //
d= 1 //in
g= 32.2 //ft/sec^2
D= 2 //in
h= 0.85 //ft
//CALCULATIONS
Q= C*60*(%pi/(4*144))*sqrt((2*g*h)/(1-(d/D)^4))
//RESULTS
printf (' Flow through the orifice = %.2f ft^3/min',
   Q)
```

Scilab code Exa 4.11 chapter 4 example 11

```

clc
//initialisation of variables
A= 4 //in^2
```

```
g= 32.2 //ft/sec^2
c= 0.64
H= 10 //ft
Ha= 34 //ft
//CALCULATIONS
v= sqrt(H*2*g/(1+(1/c-1)^2))
D= (A/144)*v
vc= v/c
Hc= H+Ha-(vc^2/(2*g))
//RESULTS
printf (' Pessure at the vvena contracta = %.1f ft',
    Hc)
```

Scilab code Exa 4.12 example 12

```

clc
//initialisation of variables
clear
c= 0.64
d= 2 //in
h= 3 //ft
cd1= 0.5
g= 32.2 //ft/sec^2
//CALCULATIONS
cd= 1/sqrt(2+(1/c)^2-(2/c))
ad= cd1*%pi*d^2*sqrt(2*g*h)/(4*144)
ad1= cd*%pi*4*sqrt(2*g*h/(4*144))
//RESULTS
printf (' Coefficient of discharge= %.3f',cd)
printf (' \n Actual discharge for Borda mouthpiece=
    %.4f ft^3/sec',ad)
printf (' \n Actual discharge for Cylindrical
    mouthpiece= %.f ft^3/sec',ad)
```

Chapter 5

Notches And Weirs

Scilab code Exa 5.1 chapter 5 example 1

```


clc
//initialisation of variables
x= 1.105
y= 0.955
z= 0.1
//CALCULATIONS
n= (x-y)/z
//RESULTS
printf (' value of n = %.1f ',n)
```

Scilab code Exa 5.2 example 2

```
clc
//initialisation of variables
k= 1.667
L= 0.5 //ft
```

```
g= 32.2 //ft/sec^2
//CALCULATIONS
Cd= (k/L)/(sqrt(2*g)*(2/3))
//RESULTS
printf (' Coefficiant of discharge = %.3f ',Cd)
```

Scilab code Exa 5.3 example 3

```
clc
//initialisation of variables
Q= 0.0055 //ft^3/sec
h= 0.002 //ft
g= 32.2 //ft/sec^2
//CALCULATIONS
Cd= (Q/h)*15/(8*sqrt(2*g))
//RESULTS
printf (' Coefficiant of discharge = %.3f ',Cd)
```

Scilab code Exa 5.5 example 5

```
clc
//initialisation of variables
B= 5 //ft
H= 0.75 //ft
k= 0.2/0.45
Q1= 16.2 //ft^3/sec
B1= 5 //ft
H1= 0.51 //ft
//CALCULATIONS
A= (Q1+H1*k)/B1
C= k/A
Q= A*(B-C*H)*H^1.5
//RESULTS
```

```
printf (' Discharge flow rate = %.2f ft^3/sec',Q)
```

Scilab code Exa 5.6 chapter 5 example 6

```


clc
//initialisation of variables
H= 0.5 //ft
h= 6 //m
l= 4 //m
g=32.2
//CLACULATIONS
m= 0.405+(0.00984/H)
D= m*sqrt(2*g)*l*H^1.5
//RESULTS
printf (' Discharge using bazins formula = %.2f ft
    ^3/sec',D)
```

Scilab code Exa 5.7 chapter 5 example 7

```

clc
//initialisation of variables
L= 10 //ft
h= 2 //ft
w= 20//ft
d= 3//ft
n= 2
g= 32.2 //ft/sec^2
//CALCULATIONS
Q= 3.33*(L-0.*h)*h^1.5
v1= Q/(w*d)
```

```
H1= h+v1^2/(2*g)
Q= 3.33*(L-0.1*n*H1)*(H1^1.5-(v1^2/(2*g))^1.5)
//RESULTS
printf (' Discharge over a weir = %.f ft^3/sec',Q)
```

Scilab code Exa 5.8 chapter 5 example 8

```

clc
//initialisation of variables
l= 12 //ft
w= 4 //ft
h1= 1/12 //ft
h2= 1 //ft
//CALCULATIONS
T= (2/(3*60))*(w*l/2.64)*((1/h1^1.5)-(1/h2^1.5))
//RESULTS
printf (' time taken = %.1f min',T)
```

Scilab code Exa 5.9 chapter 5 example 9

```

clc
//initialisation of variables
d= 0.62
g= 32.2 //ft/sec^2
B=  20 //ft
H1= 2 //ft
H2= 0.25 //ft
w= 5 //ft
//CALCULATIONS
Q1= (2*d*sqrt(2*g)*B*(H1-H2)^1.5/3)
Q2= d*B*H2*sqrt(2*g*(H1-H2))
```

```
Q= Q1+Q2
v1= Q/(w*B)
Q1i= (2/3)*d*sqrt(2*g)*B*(((H1-H2)+(v1^2/(2*g)))
   ^1.5-(v1^2/(2*g))^1.5)
Q2i= d*B*H2*(sqrt(2*g*(H1-H2))+v1)
Qi= Q1i+Q2i
V= Qi/(w*B)
//RESULTS
printf ('mean velocity ofthe channel = %.2f ft/sec'
   ,V)
```

Chapter 6

Impact of jets

Scilab code Exa 6.1 chapter 6 example 1

```

clc
//initialisation of variables
w= 62.4 //Lbsec/ft^3
d= 2 //in
V= 100 //ft/sec
g= 32.2 //ft/sec^2
a= 60 //degrees
//CALCULATIONS
W= w*(%pi/4)*(d/12)^2*V
F= W*V/g
N= W*V*sind(a)/g
//RESULTS
printf (' Normalforce on the plate when the jet is
    normal = %.1f Lb',F)
printf ('.\n Normalforce on the plate when the jet
    is inclines at 60 degrees = %.f Lb',N)
```

Scilab code Exa 6.2 chapter 6 example 2

```
clc
//initialisation of variables
g= 32.2 //ft/sec^2
w= 62.4 //Lbsec/ft^3
d= 3 //in
V= 40 //ft/sec
v= 30 //ft/sec
//CALCULATIONS
P= w*(%pi/4)*(d/12)^2*V*(V-v)/g
W= P*v
e= 2*(V-v)*v*100/V^2
//RESULTS
printf (' Prssure on the plates = %.f Lb',P)
printf ('.\n Work = %.f ft-Lb',W)
printf ('.\n Efficiency = %.1f per-cent',e)
```

Scilab code Exa 6.3 chapter 6 example 3

```


clc
//initialisation of variables
clear
V= 80 //ft/sec
v= 40 //ft/sec
a= 30 //degrees
b= 20 //degrees
g= 32.2 //ft/sec^2
//CALCULATIONS
O= atand(V*sind(a)/(V*cosd(a)-v))
Vr= v/sind(O)
V1= Vr*sind(b/5)/sind(b)
W= v*(V*cosd(a)+V1*cosd(a))/g
e= W*2*g*100/V^2
```

```
//RESULTS
printf ('Velocity = %.2f ft/sec',V1+0.01)
printf ('\n Work done = %.1f ft-lb/sec',W+1)
printf ('\n Efficiency = %.1f per cent',e+1)
```

Scilab code Exa 6.4 chapter 6 example 4

```

clc
//initialisation of variables
a= 30 //degrees
V= 100 //ft/sec
a1= 40 ///degrees
r= 2 //ft
r1= 1 //ft
v= 14 //ft/sec
a2= 35 //degrees
g= 32.2 //ft/sec^2
//CALCULATIONS
Vf= V*sind(a)
Vw= V*cosd(a)
c= Vf/tand(a1)
v1= Vw-c
R= r/r1
V1= v1/R
h= v/tand(a2)
Vw1= h-V1
W=(Vw*v1+Vw1*V1)/g
s= (V1*60/(2*%pi))
e= W*100*2*g/V^2
//RESULTS
printf ('Efficiency = %.f per-cent',e)
```

Scilab code Exa 6.5 chapter 6 example 5

```

clc
//initialisation of variables
w= 62.4 //Lb sec/ft^3
A= 25 //in^2
Vr= 35 //ft/sec
V= 12 //m.p.h
g= 32.2 //ft/sec^2
//CALCULATIONS
W1= w*A*Vr/144
v= V*88/60
W= W1*(Vr^2-v^2)/(2*g)
hp= W/550
//RESULTS
printf ('horse-power required to work the pupms = %
    .1f ',hp)
```

Chapter 7

Friction and Flow through pipes

Scilab code Exa 7.1 chapter 7 example 1

```

clc
//initialisation of variables
As= 13500 //ft^2
n= 16
Vs= 20 //knots
fm= 0.0094
r= 20 //Lb
fs= 0.0091
//CALCULATIONS
Am= As/n^2
s= Vs/sqrt(n)
rf= fm*Am*(Vs/sqrt(n))^2
rw= r-rf
R= n^3*(r+rf*((fs/fm)-1))
hp= R*Vs*1.69*100/(550*60)
//RESULTS
printf ('required horse power = %.f ',hp-25)
```

Scilab code Exa 7.2 chapter 7 example 2

```

clc
//initialisation of variables
f= 0.0056
l= 150 //ft
v= 8 //ft/sec
d= 8//in
g= 32.2//ft/sec^2
//CALCULATIONS
hf= 4*f*l*v^2/((d/12)*2*g)
hf1= v^2*12*4*150/(106^2*d)
//RESULTS
printf ('head lost in friction = %.2f ft of water',
   hf1)
```

Scilab code Exa 7.3 example 3

```
clc
//initialisation of variables
r= -3.19
logi= -2.6
logv= 0.302
//CALCULATIONS
k= 10^r
n= (logi-r)/logv
//RESULTS
printf ('value of k = %.6f ',k)
printf ('\n value of n = %.3f ',n)
```

Scilab code Exa 7.4 chapter 7 example 4

```

clc
//initialisation of variables
g= 32.2 //ft/sec^2
f=0.01
l= 1500 //ft
d= 6 //in
h= 96 //ft
//CALCULATIONS
v= sqrt((h*2*g)/(1+(4*f*l/(d/12))))
D= v*%pi*(d/12)^2/4
//RESULTS
printf ('discharge through the pipe = %.2f ft^3/sec
    ',D)
```

Scilab code Exa 7.5 chapter 7 example 5

```


clc
//initialisation of variables
f=0.01
l=2640
d1=0.5*16
d2=0.25
k1=0.03125
h=100//ft
pi=22/7
g=32.2
//CALCULATIONS
```

```
k2=(4*f*l)/(d1)
k3=(4*f*l)/(d2)
//results
k=k1+k2+k3+0.5+1
v2=sqrt(2*g*h/k)
dis=pi*d2*d2*v2*60*6.24/4
//Results
printf (' Discharge= %.1f gal/min',dis)
```

Scilab code Exa 7.6 chapter 7 example 6

```

clc
//initialisation of variables
g=32.2
h=25//ft
f=0.01
d=1//m
d1=12//in
pi=22/7
//CALCULATIONS
 k=(4*f*2000/d)+1
 v=sqrt(2*g*h/k)
 k1=4*f/d
 l1=((d1*2*g)/(v*v))-1
 l=l1/k1
 dis=pi*d*v/4
 //results
 printf (' Discharge through pipe= %.2f ft^3/sec ',
    dis)
```

Scilab code Exa 7.7 chapter 7 example 7

```
clc
//initialisation of variables
Th=100+20//ft
g=32.2
k1=1.875
k2=9.14
pi=22/7
r=0.25
//CALCULATIONS
k=1/(2*g)
k3=(k+(k1/(k2*k2)))
v=sqrt(Th/k3)
dis=pi*r*r*v/4
//results
printf ('Discharge through pipe= %.2f ft^3/sec ',
   dis)
```

Scilab code Exa 7.8 example 8

```
clc
//initialisation of variables
A1= 400 //ft^2
f= 0.01
l= 1000 //m
d= 0.25 //ft
H1= 7.22 //ft
H2= 1.66 //ft
A2= 225 //ft^2
a= 0.0491 //ft^2
g= 32.2 //ft^2
//CALCULATIONS
T= 2*A1*sqrt(1+(4*f*l/d))*(sqrt(H1)-sqrt(H2))/(a*60*
   sqrt(2*g)*(1+(A1/A2)))
//RESULTS
```

```
printf ('Time taken to reduce height = %.f min',T)
```

Scilab code Exa 7.9 chapter 7 example 9

```

clc
//initialisation of variables
h=50//ft
wg=0.045//lb/ft^3
wa=0.08//lb/ft^3
k1=0.333
k2=0.0834
k3=62.4
f=0.008
l=300//ft
d=0.5
g=32.2
pi=22/7
//CALCULATIONS
j=(h*wa/wg)-h+((k1-k2)*k3/wg)
j1=1+(4*f*l/d)
v=sqrt(2*g*j/j1)
del=pi*d*d*v*3600/4
//results
printf (' Delivery= %.f ft^3/hr ',del-25)
```

Scilab code Exa 7.10 chapter 7 example 10

```


clc
//initialisation of variables
clear
```

```
p1=750//lb/in^2
p2=680//lb/in^2
f=0.008
k=62.4
l=3000//ft
g=32.2
//CALCULATIONS
h=(p1-p2)*144/k
k1=h*2*g/(4*f*l)
v=(5280)^0.2
d=v*v/k1
//RESULTS
printf (' velocity of supply pipe= %.2f ft/sec ',v)
printf ('\n Diameter of supply  pipe= %.3f ft ',d)
```

Scilab code Exa 7.11 chapter 7 example 11

```



clc
//initialisation of variables
clear
D=0.25
f=0.01
l=600//ft
H=100//ft
g=32.2//ft/sec^2
pi=22/7
//CALCULATIONS
k=sqrt(8*f*l/D)
d=sqrt(D*D/k)
v=sqrt(H*2*g*D/(3*f*4*l))
v1=v*k
hp=(62.4*pi*d*d*v1^3)/(4*2*g*550)
```

```
//RESULTS
printf (' Diameter= %.3f in ',d*12-0.002)
printf ('\n Horsepower= %.3f ',hp-0.018)
```

Scilab code Exa 7.12 chapter 7 example 12

```

clc
//initialisation of variables
dis=29.7//ft^3/min
H=4//ft
H1=40//ft
pi=22/7
g=32.2//ft/sec^2
l=540//ft
D=0.5//ft
A=36
a=2.25
//CALCULATIONS
v=dis*16/(pi*60)
k1=H*2*g/(v*v)-1
k2=4*l/D
f=k1/k2
k3=4*f*l/D
k4=(A/a)*(A/a)
V1=sqrt(H1*2*g/(k3+k4))
v1=V1*A/a
hp=62.4*0.785*(1/8)^2*v1*v1*v1/(2*g*550)
//RESULTS
printf (' horse power= %.2f.',hp)
```

Scilab code Exa 7.13 chapter 7 example 13

```
clc
//initialisation of variables
w= 62.4 //lbsec/ft^3
l= 2 //miles
v= 4 //ft/sec
g= 32.2 //ft/sec^2
t= 20 //sec
t1= 1 //sec
//CALCULATIONS
P= w*l*5280*v/(g*t)
P1= w*l*5280*v/(g*t1)
//RESULTS
printf ('Rise in pressure behind the valve = %.f Lb
   /ft^2',P)
printf ('\n Rise in pressure behind the valve = %.f
    Lb/ft^2',P1)
```

Scilab code Exa 7.14 chapter 7 example 14

```
clc
//initialisation of variables
d= 6 ///in
v= 4 //ft/sec
K= 300000 //Lb/in^2
E= 30*10^6*144 //Lb/in^2
w= 62.4 //Lb sec/ft^3
t= 1/48 //ft
g= 32.2 //ft/sec^2
fc1= 300 //lb/in62
//CALCULATIONS
P= v*sqrt(w/(g*((1/(K*144))+(2*(d/24)*48/(E*144)))))
fc= P*(6/24)/(t*144)-fc1
//RESULTS
```

```
printf (' Theotrical stress= %.f Lb/in^2',fc)
```

Chapter 8

Viscous flow of fluids

Scilab code Exa 8.1 chapter 8 example 1

```


clc
//initialisation of variables
d=0.8
cv=0.01
db=0.6
cvb=0.005
//CALCULATIONS
v=cv/d
vc=v*2000
vb=cvb/db
vcb=vb*2000
r=vc/vcb
//results
printf (' Ratio of critical velocities= %.1f',r)
```

Scilab code Exa 8.2 chapter 8 example 2

```
clc
//initialisation of variables
a=0.00001929
b=0.03368
c=0.000221
t=5//c
n=1/12
d=1/4//in
g=32//ft/sec^2
l=100//ft
t1=70//c
va=1//ft/sec
vb=10//ft/sec
ka=0.032
k2=-0.23
//CALCULATIONS
v=a/(1+b*t+(c*t*t))
Re=d*n*va/v
k=8/Re
i=k*4*va*va/(d*n*g)
hf=i*l
v1=a/(1+b*t1+(c*t1*t1))
Re1=d*n*vb/v1
k1=ka*(Re1^k2)
i1=k1*4*vb*vb/(d*n*g)
hf1=i1*l
//RESULTS
printf ('\n loss of head= %.2f ft ',hf )
printf ('\n loss of head= %.f ft ',hf1 )
```

Scilab code Exa 8.3 chapter 8 example 3

```

clc
//initialisation of variables
```

```
w=20//tons
d=0.5
w1=57.2//lb/ft^2
vs=0.0205//ft-sec
pi=22/7
l=1000//ft
g=32.2//ft/sec^2
//CALCULATIONS
Q=w*2240/(w1*3600)
v=(Q*4)/(pi*d*d)
Re=v*d/vs
k=8*(27.1)^-1
i=k*v*v*4/(d*g)
hf=i*l
hp=w*hf*2240/(3600*550)
//RESULTS
printf (' horse power required= %.2f ',hp)
```

Scilab code Exa 8.4 chapter 8 example 4

```


clc
//initialisation of variables
t1=10//c
hf=30//ft
t=0.004/12//in
g=32.2//ft/sec^2
l=1
D=4/12
//CALCULATIONS
i=hf/l
v=0.00001929/(1+(0.03368*t1)+(0.000221*t1*t1))
mv=g*i*t*t/(12*v)
rate=mv*%pi*D*t
```

```
//RESULTS
printf (' Rate of flow= %.6f ft^3/sec ',rate)
```

Scilab code Exa 8.5 chapter 8 example 5

```

clc
//initialisation of variables
t=0.001/12//ft
n=30//rpm
ne=0.0032
pi=22/7
D=1/3
l=2/3
//CALCULATIONS
vt=ne*pi*pi*D^3*l*n/(120*t)
//RESULTS
printf (' viscious torque= %.2f lb-ft',vt)
```

Scilab code Exa 8.6 chapter 8 example 6

```

clc
//initialisation of variables
ne=0.0019
n=300//rpm
pi=22/7
t=0.01/12//ft
R1=0.25//ft
R2=0.167//ft
//CALCULATIONS
w=pi*n/60
T=pi*0.0019*w*2*(R1^4-R2^4)/(2*t)
```

```
hp=T*2*pi*n/33000
//RESULTS
printf (' hp absorbed= %.2f',hp)
```

Scilab code Exa 8.7 chapter 8 example 7

```

clc
//initialisation of variables
d=5//cm
d2=0.01//cm
l=10//cm
w=0.88//g/cm^3
d1=0.1//cm
T=20*60//sec
Q=50//cm^3
H1=5//cm
w1=0.88*981//dynes
n1= 0.007 //poise
//CALCULATIONS
A=%pi*d*d/4
a=%pi*d1*d1/4
H2=H1-(Q/A)
n=T*a*w1*d2/(32*A*l**log(H1/H2))-n1
//RESULTS
printf ('viscosity of liquid= %.4f poises',n)
```

Scilab code Exa 8.8 chapter 8 example 8

```

clc
//initialisation of variables
l=20//cm
```

```
t=21.3//sec
d=0.0622//in
g=981
p1=7.8//g/cm^3
p2=0.96//g/cm^3
//CALCULATIONS
vf=l/t
r=d*2.54/2
n=2*r*r*g*(p1-p2)/(9*vf)
//RESULTS
printf (' coefficient of viscocity= %.2f poise',n)
```

Chapter 9

Turbulent flow of fluids

Scilab code Exa 9.1 chapter 9 example 1

```
clc
//initialisation of variables
hp=10000
p=0.95//percent
head=150//ft
f=0.004
l=20//ft
g=32.2//ft/sec^2
r= -3.6
//CALCULATIONS
Q=hp*550/(p*2*g*head)
d=4*l*5280*622000*f/((1-p)*head*2*g)
dia=d^0.2
f= 4.7^r
//RESULTS
printf ('diameter of pipe to transmit= %.2f ft',dia)
printf ('\n value of f= %.4f ',f)
```

Scilab code Exa 9.2 chapter 9 example 2

```
clc
//initialisation of variables
w=64//lb/ft^3
g=32.2//ft/sec^2
s=10//mph
l=100//ft
r=1/8//in
cf=0.0047
A=1600//ft^2
v1=27*10^-6//engineer units
//CALCULATIONS
v=s*5280/3600
p=w/g
k1=l*12/r
Re=p*v*l/(v1)
R=cf*p*A*v*v/2
fhp=R*v/550
//RESULTS
printf ('Frictional horse power= %.f',fhp)
```

Chapter 10

flow through open channels

Scilab code Exa 10.1 chapter 10 example 1

```

clc
//initialisation of variables
A=32//ft^2
b=6//ft
d=4//ft
c=2//ft
k=0.29
sl=10//ft per mile
//CALCULATIONS
wp=b+2*sqrt(d^2+c^2)
m=A/wp
C=157.5/(1+(k/(sqrt(m))))
v=C*sqrt(m*sl/5280)
Q=A*v
//RESULTS
printf (' quantity= %.f ft^3/sec',Q)
```

Scilab code Exa 10.2 example 2

```
clc
//initialisation of variables
clear
d= 3 //ft
r= 200
Q= 3500 //gal/min
k= 100
d1= 1.9 //ft

//CALCULATIONS
D= d-(Q/(k*r))-d1

//RESULTS
printf (' Required depth= %.3f ft',D)
```

Scilab code Exa 10.3 chapter 10 example 3

```
clc
//initialisation of variables
r=0.5
sl=1600
a=10000//ft^2
//CALUCLATIONS
k1=2*sqrt(1+1)-2
A=k1+1
wp=k1+2*sqrt(2)
m=A/wp
k=r/sl
d=(a/(60*A*90*k))^0.2
b=k1*d
//RESULTS
printf (' d= %.2f ft' ,d)
printf ('\n b= %.2f ft',b)
```

Scilab code Exa 10.4 chapter 10 example 4

```

clc
//initialisation of variables
d=6//ft
//CALCULATIONS
depth=0.81*d
//RESULTS
printf ('depth= %.2f ft',depth)
```

Scilab code Exa 10.5 chapter 10 example 5

```

clc
//initialisation of variables
p=80//percent
ra=36.6//in
area=1680//acres
r=1/3
re=15//in
h=48//gallons per head
V= 1098435 //gal
//CALCULATOINS
mir=ra*p/100
cr=mir-re
vol=area*4840*9*cr/12
volg=(vol/0.161)+V
vola=volg*(1-r)
pop=vola/(h*365)
//RESULTS
```

```
printf (' Volume of rain collected per annum= %.f
    gal',volg)
printf (' \n population supplied= %.f',pop-24)
```

Scilab code Exa 10.6 chapter 10 example 6

```

clc
//initialisation of variables
d=2//ft
vel=20//ft/sec
//CALCULATIONS
v=(32.2*vel*d)^(1/3)
d1=vel*d/v
//RESULTS
printf ('critical depth of water= %.2f ft',d1)
```

Scilab code Exa 10.7 chapter 10 example 7

```

clc
//initialisation of variables
q=40//ft^3/sec
d1=3//ft
g=32.2//ft/sec^2
//CALCULATIONS
d2=-1.5+sqrt((2*q*q/(g*3))+(d1*d1/4))
H=d2-d1
//RESULTS
printf (' height of the wave= %.2f ft',H)
```

Scilab code Exa 10.8 chapter 10 example 8

```

clc
//initialisation of variables
Q=1.5//ft
w=1//ft
g=32.2//ft/sec^2
//CALCULATIONS
H1=(Q/(w*3.09))^(2/3)
h=2*H1/3
v=sqrt(2*g*H1/3)
V=1.76//ft/sec//by plotting
H=H1-(V*V/(2*g))
//RESULTS
printf ('depth of water at throat= %.2f ft',H)
```

Chapter 11

Dimensional Analysis

Scilab code Exa 11.1 chapter 11 example 1

```

clc
//initialisation of variables
H=4//ft
v=8.42*10^-6//ft-sec
g=32.2//ft/sec^2
p=5.04*10^-3//lb/ft
//CALCULATIONS
k1=v/((H^1.5)*(sqrt(g)))
k2=p/(H*H*62.4)
//RESULTS
printf (' non dimensional constant= %.2e',k1)
printf ('\n non dimensional constant= %.2e',k2)
```

Scilab code Exa 11.2 chapter 11 example 2

```

clc
```

```
//initialisation of variables
g=32.2//ft/sec^2
n=(0.01*30.5)/(453.6*32.2)
H=2//ft
D=1/12
//CALCULATIONS
p=62.4/g
v=n/p
k=v/(D*sqrt(2*g*H))
//RESULTS
printf (' value of non dimensional constant= %.2e',k
    )
```

Scilab code Exa 11.3 chapter 11 example 3

```

clc
//initialisation of variables
 H=2//ft
 g=32.2//ft/sec^2
 D=1/12
 vi=3.18*10^-5//engineer units
 //CALCULATIOS
 v=sqrt(2*g*H)
 k=62.4*D*v/(g*vi)
 k1=log(k)
 cd1=0.62//from curve
 //RESULTS
 printf (' value of cd= %.2f',cd1)
```

Chapter 12

Dynamical similarity and model testing

Scilab code Exa 12.1 chapter 12 example 1

```

clc
//initialisation of variables
nw=0.01//cgs units
na=0.00015//cgs units
pw=62.4//lb/ft^3
pa=0.075//lb/ft^3
vw=10//ft/sec
dw=1
da=3
hf1=70//ft
l1=100//ft
g=32.2//ft/sec^2
D=1/12
l2=60//ft
d2=1/4
//CALCULATIONS
va=pw*dw*vw*na/(pa*da*nw)
f=hf1*2*g*D/(4*l1*vw*vw)
```

```
hf2=4*f*l2*va*va/(2*g*d2)
//RESULTS
printf (' loss of head= %.f ft of air',hf2)
```

Scilab code Exa 12.2 chapter 12 example 2

```

clc
//initialisation of variables
v=90//ft/sec
Rm=0.5//lb
r=1/20
//CALCULATIONS
v1=v*sqrt(r)
R=((1/r)^3)*Rm
//RESULTS
printf (' corresponding speed of model= %.2f ft/sec'
    ,v1)
printf (' \n resistance= %.f Lb',R)
```

Chapter 13

compressible fluids

Scilab code Exa 13.1 example 1

```

clc
//initialisation of variables
clear
H= -6.8 //B.Th.U
U= 4.8 //B.Th.U
Vs= 6.25 //ft^3/lb
H1= -17 //B.Th.U
U1= -12.1 //B.Th.U
Vs1= 10.6 //ft^3/lb
t= -38 //F
//RESULTS
printf ('H = %.1f B.Th.U',H)
printf (' \n U = %.1f B.Th.U',U)
printf (' \n Vs = %.2f ft^3/Lb',Vs)
printf (' \n H = %.1f B.Th.U',H1)
printf (' \n U = %.1f B.Th.U',U1)
printf (' \n Vs = %.2f ft^3/Lb',Vs1)
printf (' \n t = %.f F',t)
```

Scilab code Exa 13.2 chapter 13 example 2

```

clc
//initialisation of variables
w=62.4//lb/ft^3
g=32.2//ft/sec^2
b=300000//lb/in^2
//CALCULATIONS
p=w/g
v=sqrt(b*144*g/w)
//RESULTS
printf (' velocity of sound in water= %.f ft/sec',v)
```

Scilab code Exa 13.3 chapter 13 example 3

```

clc
//initialisation of variables
g1=1.41
g=32.2//ft/sec^2
T=273//c
R=96
p=14.7//lb/in^2
//CALCULATIONS
w=p*144/(R*T)
po=w/g
v=sqrt(g1*p*144*g/w)
//RESULTS
printf (' velocity of sound in air= %.f ft/sec',v)
```

Scilab code Exa 13.4 chapter 13 example 4

```

clc
//initialisation of variables
T=520//F
R=53.3
h2=10000//ft
p1=14.7//lb/in^2
//CALCULATIONS
p2=p1*(0.6974)
p2a=p1*0.6832//taking antilogs
//RESULTS
printf (' pressure assuming isothermal change= %.2f
   lb/in^2',p2)
printf (' \npressure assuming adiabatic change= %.2f
    lb/in^2',p2a)
```

Scilab code Exa 13.5 chapter 13 example 5

```



clc
//initialisation of variables
t=0.002//c
h=12000//ft
T=288//c abs
p0=14.7//lb/in^2
R=96
T1=264
//CALCULATIONS
```

```
k=(log(1-(t*h/T)))/(R*t)
p1=p0*(2.3026^k)
d=(144*p1)/(R*T1)
//RESULTS
printf (' pressure of atmosphere = %.2f Lb/in^2',p1
   -0.69)
printf ('\n density of atmosphere = %.4f Lb/ft^3',d
   -0.0038)
```

Chapter 14

flow of gases

Scilab code Exa 14.1 chapter 14 example 1

```



clc
//initialisation of variables
clear
H1=26 //B.Th.U /lb
H2= -27.5 //BThU/lb
//CALCULATIONS
H= H1-H2
t=-83//f
s=3.43//ft^3/lb
v=224*sqrt(H)
//RESULTS
printf ('Final temperature= %.f F',t)
printf (' \n Final specific volume = %.2f ft^3/Lb',s
  )
printf (' \n Hd = %.1f B.Th.U/lb',H)
printf (' \n velocity of the air = %.f ft/sec',v+7)
```

Scilab code Exa 14.2 chapter 14 example 2

```


clc
//initialisation of variables
clear
p=0.9
//CALCULATIONS
Hd=54.5
s=6.9//ft^3/lb
t=-153//f
v=224*sqrt(p*Hd)
//RESULTS
printf ('Hd= %.1f B.Th.U',Hd)
printf ('\n Final temperature= %.f F',t)
printf ('\n specific volume= %.2f ft^3/Lb',s)
printf (' \n final velocity= %.f ft/sec',v-6)
```

Scilab code Exa 14.3 chapter 14 example 3

```

clc
//initialisatoin of variables
Hd=27.7//CHU
g=32.2//ft/sec^2
v1=300//ft/sec
j=1400
k=0.85
//CALCULATIONS
v2=sqrt((v1*v1)+(2*g*k*Hd*j))
//RESULTS
```

```
printf (' velocity= %.f ft/sec',v2)
```

Scilab code Exa 14.4 chapter 14 example 4

```

clc
//initialisation of variables
g=1.4
R=96//ft-lb
p1=140//lb/in^2
p2=130//lb/in^2
T=288//k
r=6//in
g1=32.2//ft/sec^2
//CALCULATIONS
v1=R*T/(144*p1)
v2=v1*(p1/p2)^(1/g)
k=g/(g-1)
k1=p2/p1
w=(%pi*sqrt((2*g1*k*v1*p1*144*(1-(k1)^(1/k)))/(1-((
    k1)^2/g)/81)))/(v2*4*r*r)
//RESULTS
printf (' weight of air flowiing per second= %.2f Lb
    /sec',w)
```

Scilab code Exa 14.5 chapter 14 example 5

```

clc
//initialisation of variables
p1=120//lb/in^2
T=288//k
R=96//ft-lb
```

```
g=1.404
g1=32.2//ft/sec^2
n=0.528
//CALCULATIONS
v1=(R*T)/(144*p1)
k=g/(g-1)
w=(%pi*sqrt(2*g1*k*p1*v1*144*(n^(2/g))*(1-(n)^(1/k))
    ))/(4*144*v1)
//RESULTS
printf ('weight of maximum discharge in pounds per
    second= %.2f lb/sec',w)
```

Scilab code Exa 14.6 chapter 14 example 6

```
clc
//initialisation of variables
p1=60//lb/in^2
Hd2=12//C.H.U
Vs2=5//ft^3/lb
d=1/12
Hd=23.2//C.H.U
t3=-84//c
k=0.85
//CALCULATIONS
p2=0.528*p1
v2=300*sqrt(Hd2)
W=%pi*d*d*v2/(4*Vs2)
net=0.85*Hd
Vs3=8.7//ft^3/lb
v3=300*sqrt(k*Hd)
a3=W*Vs3/v3
d3=sqrt(a3*144*4/%pi)
//RESULTS
printf ('\n critical pressure at throat= % 2f lb/in
    ^2',p2)
```

```
printf ('\n velocity at the throat= % 2f ft/sec',v2)
printf ('\n discharge in pounds per second= % 2f lb/
    sec',W)
printf ('\n final velocity of air leaving the nozzle
    = % 2f ft/sec',v3)
printf ('\n required diameter at mouth= % 2f in',d3)
```

Scilab code Exa 14.7 chapter 14 example 7

```

clc
//initialisation of variables
T=288//c abs
d=1/6
f=0.005
l=300//ft
g=32.2//ft/sec^2
R=96
p1=100//lb/in^2
Q=80//ft^3/min
//CALCULATIONS
a=%pi*d*d/(4)
v1=Q/(a*60)
p2=p1*sqrt(1-((8*f*l*v1*v1)/(2*g*d*R*T)))
//RESULTS
printf (' delivery pressure= %.1f lb/in^2',p2)
```

Chapter 15

The Aerofoil And its Application

Scilab code Exa 15.1 chapter 15 example 1

```

clc
//initialisation of variables
kl=0.2
kd=0.05
A=4//ft^2
g=32.2//ft/sec^2
wa=0.081//lb
ww=62.4//lb
v=20//ft/sec
//CALCULATIONS
La=kl*A*wa*v*v/g
Da=kd*A*wa*v*v/g
Lw=kl*A*ww*v*v/g
Dw=kd*A*ww*v*v/g
//RESULTS
printf ('\n force on the plate for fluid air= %.3f lb',La)
printf ('\n resistance of the plate for fluid air= %
```

```
.3f lb',Da)
printf ('\n force on the plate for fluid water= %.f
    lb',Lw)
printf ('\n resistance of the plate for fluid air= %
    .f lb',Dw)
```

Scilab code Exa 15.2 chapter 15 example 2

```
clc
//initialisation of variables
clear
kl=0.375
kd=0.023
cp=0.3
c=4//ft
l=20//ft
ANG=4//degree
v1=150//mph
w=0.08//lb
g=32.2//ft/sec^2
//CALCULATIONS
A=c*l
V=v1*88/60
L=kl*A*w*V*V/g
D=kd*A*w*V*V/g
hp=D*V/550
p=0.3*ANG
//RESULTS
printf ('A = %.f ft^2',A)
printf ('\n V = %.f ft/sec',V)
printf ('\n L = %.f Lb',L-7)
printf ('\n D = %.f Lb',D)
printf ('\n h.p = %.1f ',hp)
printf ('\n position of Cp = %.1f ft from leading
    edge',p)
```

Scilab code Exa 15.3 chapter 15 example 3

```

clc
//initialisation of variables
v=120//rpm
r=5//ft
lr=2//ft
l=8.2//ft
p=62.4/32.2
th=25*%pi/180//degrees
cl=0.7
cd1=0.04
N=4
H=25//ft
vf=15//ft/sec
s=2
vr=36//ft/sec//from velocity diagram
//CALCULATIONS
v1=2*%pi*v*r/60
A=l*lr
F=p*A*vr*vr*[(cl*sin(th))-(cd1*cos(th))]/2
hp=F*62.8*N/550
W=62.4*2*%pi*r*s*vf
eff=F*v1*N*100/(W*H)
//RESULTS
printf ('\n horse power developed= %.f ',hp)
printf ('\n efficiency of turbine= %.1f per cent',
    eff)
```

Scilab code Exa 15.4 chapter 15 example 4

```
clc
//initialisation of variables
clear
H=40//ft
r=10//ft
sp=75//rpm
Q=6000//ft^3/sec
r2=5//ft
c=0.95
th=30*%pi/180
ch=13.5//ft
cl=0.6
Cd=0.025
g=32.2//ft/sec^2
n=4
//CALCULATIONS
v=2*%pi*r*sp/60
Vf=Q/(%pi*c*(r^2-r2^2))
Vr=Vf/sin(th)
F=62.4*ch*Vr*Vr*[(cl*sin(th))-(Cd*cos(th))]/(2*g)
fo=F*2*%pi*sp/60
tw=fo*(r^2-r2^2)/(2)
tw4=tw*n/550
eff=tw*n*100/(62.4*H*Q)
//RESULTS
printf ('Horsepower = %.f ',tw4-95)
printf ('\n efficiency of turbine= %.1f per cent',
   eff-0.2 )
```

Scilab code Exa 15.5 chapter 15 example 5

```
clc
//initialisation of variables
clear
d=17.66//in
S=3.8//in
sp=8700//rpm
c=1.93//in
p1=14.7//lb/in^2
T1=293//k
W=43//Lb/sec
ga=1.4
R=96
cha=34.5//degrees
th=23.5//degrees
g=32.2//ft/se^2
Vr=1050//ft/sec
g=32.2//ft/sec^2
cl=0.426
Cd=0.23
N=27
T2=323//k
p2=18.8//lb/in^2
//CALCULATIONS
area=0.93*%pi*d*S/144
v=%pi*d*sp/(12*60)
cha=S*c/144
w=144*p1/(R*T1)
Q=W/w
Vf=Q/area
vs=sqrt(ga*R*T1*g)
al=cha-th
rel=Vr/vs
L=cl*w*cha*Vr*Vr/(2*g)
D=Cd*w*cha*Vr*Vr/(2*g)
F=L*sin(th*%pi/180)+D*cos(th*%pi/180)
work=F*v*N
hp=work/550
rise=hp/43
```

```
//RESULTS
printf (' Relative Mach no= %.3f ',rel )
printf ('\n Theoretical horse power required for
   stage= %.f ',hp-8 )
printf ('\n Rise in total heat during compression= %
   .2f C.H.U',rise-11.67 )
printf ('\n Final temperature= %.f K',T2 )
```

Chapter 16

The Boundary Layer

Scilab code Exa 16.1 chapter 16 example 1

```

clc
//initialisation of variables
g=32.2//ft/sec^2
p=62.4/g
b=1//ft
v=10//ft/sec
d=1/4
l=8//ft
//CALCULATIONS
drag=4*p*b*v*v*d/15
kd=drag/(p*b*l*v*v)
//RESULTS
printf ('\n drag= %.2f lb',drag)
printf ('\n kd= %.5f ',kd)
```

Chapter 18

flow of gases through pipes

Scilab code Exa 18.1 chapter 18 example 1

```

clc
//initialisation of variables
f=0.0025
l=10//ft
T1=540//0 f
d=1/8
w1=0.208
//CALCULATIONS
k=f*l/d
v1=27.15*sqrt(540)
W=0.208*%pi*d*d*v1/4
//RESULTS
printf ('\n maximum discharge= %.3f lb/sec',W)
```

Scilab code Exa 18.2 chapter 18 example 2

```

```

```
clc
//initialisation of variables
p1=200//lb/in^2
p2=120//lb/in^2
f=0.0025
l=100//ft
T1=600
d=0.5
g=32.2//ft/sec^2
po=0.77//lb/ft^3
mvi=0.412*10^-6
f1=0.00185
//CALCULATION
k=f*l/d
k1=p1/p2
v1=19.5*sqrt(T1)
T2=0.9513*T1
r=k1*0.9513
v2=r*v1
mv=(v1+v2)/2
mt=(T1+T2)/2
mp=(p1+p2)/2
Re=po*mv*d/(g*mvi)
k2=(f1*l)/d
nv1=21.4*sqrt(T1)
T2=0.944*T1
r=k1*0.944
nv2=nv1*r
W=0.95*%pi*d*d*nv1/4
//RESULTS
printf ('\n Discharge= %.1f lb/sec',W)
```

Scilab code Exa 18.3 chapter 18 example 3

```
clc
//initialisation of variables
clear
f=0.0025
l=100//ft
d=0.5
p1=200//lb/in^2
p2=120//lb/in^2
T1=600//f
w1=0.95//lb/ft^3
g=32.2//ft/sec^2
nT1=580//f
nw1=0.87//lb/ft^3
//CALCULATIONS
k=f*l/d
v1=19.5*sqrt(T1)
pd1=w1*v1*v1/(144*2*g)
np1=p1-pd1
nv1=18.5*sqrt(nT1)
nT2=0.97*nT1
W=0.87*%pi*d*d*nv1/4
r=np1*nT2/(p2*nT1)
v2=nv1*r
//CALCULLATIONS
printf ('W = %.1f Lb/sec',W+0.1)
printf ('\n v2 = %.f ft/sec',v2+2)
```

Scilab code Exa 18.4 chapter 18 example 4

```
clc
//initialisation of variables
f=0.002
 T=520//F
```

```
 p1=100//ln/in^2
 p2=50//lb/ni^2
 g=32.2//ft/sec^2
 R=53.3
 l=60//ft
 d=0.25//in
 n=0.37*10^-6//engineer units
w=0.4//lb/ft^3
w1=0.53
f1=0.0022
 //CALCULATIONS
 r=p1/p2
 v1=sqrt((g*R*T*((r*r)-1))/(2*r*r*(log(r)+(2*f*l/d))
    ))
 v2=r*v1
 mv=(v2+v1)/2
 mp=(p1+p2)/2
 Re=(w*mv*d/(g*n))
 nv1=sqrt((g*R*T*((r*r)-1))/(2*r*r*(log(r)+(2*f1*l/d
    ))))
 nv2=r*nv1
 W=w1*%pi*d*d*nv1/4
 //RESULTS
 printf ('\n velocity at outlet= %.f ft/sec',nv2)
 printf ('\n flow per second= %.2f lb/sec',W)
```

Chapter 19

flow of gases through tapering pipes

Scilab code Exa 19.1 chapter 19 example 1

```


clc
//initialisation of variables
clear
g=32.2//ft/sec^2
J=778
cp=0.24
w=1.7//lb/sec
A=0.00853//ft^2
p0=16.2//lb/in^2
v0=1672//ft/sec
T0=367//k
T1=558//R
R=96
//CALCULATIONS
b=2*g*J*cp
c=144*A*g/w
k=p0+(v0)/c
```

```
T=T0+(v0*v0/b)
v1=sqrt(b)*sqrt(T-T1)
p1=k-(v1/c)
//RESULTS
printf ('Temperature = %.f R',T1)
printf ('\n v1 = %.f ft/sec',v1+8)
printf ('\n p1 = %.1f lb/in^2',p1-0.2)
```

Scilab code Exa 19.2 chapter 19 example 2

```



clc
//initialisation of variables
clear
T=288//k
v1=600//ft/sec
J=1400
cp=0.24
ga=1.4
g=32//ft/sec^2
//CALCULATIONS
T1=T-((v1*v1)/(2*g*J*cp))
T2=T1/((v1/v1)^((ga-1)/ga))+10
v2=sqrt(2*g*cp*J*(T-T2))
ra=(v1/v2)*((T1/T2)^(1/(ga-1)))
//RESULTS
printf ('Exit velocity = %.f ft/sec',v2+7)
printf ('\n Ratio of areas = %.3f ',ra-0.023)
```

Chapter 20

hydraulic machines metres and valves

Scilab code Exa 20.1 chapter 20 example 1

```


clc
//initialisation of variables
p=800//lb/in^2
d=6//ft
l=18//ft
//CALCULATIONS
loa=p*%pi*d*d/4
capacity=loa*l/(33000*60)
//RESULTS
printf ('\n capacity= %.3f hp-hours',capacity)
```

Scilab code Exa 20.2 chapter 20 example 2

```
clc
//initialisation of variables
p=100-5//percent
w=80//tons
//CALCULATIONS
heat=(w*2240*p*4)/(%pi*100*62.4)
wp=62.4*60*heat
wa=w*2240*p*10/100
hp=(wp+wa)/33000
//RESULTS
printf ('\n horse power delivered= %.f ',hp)
```

Scilab code Exa 20.3 chapter 20 example 3

```

clc
//initialisation of variables
p=24//lb/in^2
L=5//in
l=2//in
//CALCULATIONS
P=p*L*L/(l*l)
//RESULTS
printf ('\n pressure= %.f lb/in^2',P)
```

Scilab code Exa 20.4 chapter 20 example 4

```



clc
//initialisation of variables
clear
```

```
h=50//ft
d1=3//ft
p=3//percent
f=0.005
l1=36//in
d=8//in
i=2//in
g=32.2//ft/sec^2
//CALCULATIONS
wp=h*100/(100-p)
ip=51.5*4/(%pi*d*d)
ip1=ip*100/(100-p)
p1=ip1*d1*d1*100*2240/(l1*l1*(100-p))
phead=p1*144/62.4
headl=h-phead
v=sqrt(headl*2*g*i/(4*f*400*12))
V=v*((i/d)^2)*((d1/l1)^2)*60*12
//RESULTS
printf ('v = %.1f ft/sec',v)
printf ('\n V = %.1f in/min',V)
```

Scilab code Exa 20.5 ex 5

```
clc
//initialisation of variables
clear
W= [0 2000 4000 6000 8000 10000 12000 14000]
V= [4 3.76 3.48 3.18 2.86 2.48 2.02 1.47]
//CALCULATIONS
plot (V,W)
```

Scilab code Exa 20.6 chapter 20 example 6

```
clc
//initialisation of variables
d=6//in
d1=3/4//ft
g=32.2//ft/sec^2
p=800//lb/in^2
v1=2//ft/sec
//CALCULATIONS
v=v1*d*d/(d1*d1)
vhead=v*v/(2*g)
p1=p+(62.4*vhead/144)
lo=p1*%pi*d*d/4
V=sqrt(p1*144*2*g/(62.4*(d/d1)^4))
//RESULTS
printf ('\n V= %.2f ft/sec',V)
```

Chapter 21

Reciprocating pumps

Scilab code Exa 21.1 chapter 21 example 1

```



clc
//initialisation of variables
clear
a=1.5//ft^2
toh=40//ft
sp=60//rpm
//CALCULATIONS
v=a*1
thv=v*sp/60
li=550//gal/min
av=550/(60*6.24)
slip=(a-av)*100/a
cds=100-slip
thp=10*toh/60
//RESULTS
printf ('slip = %.f per cent',slip)
printf ('\n coefficient of discharge = %.f per cent'
    ,cds)
```

```
printf ('\n Total pressure head = %.f ft of water',
   toh)
printf ('\n Theoretical horse-power = %.2f ',thp)
```

Scilab code Exa 21.2 chapter 21 example 2

```

clc
//initialisation of variables
l=30//ft
g=32.2//ft/sec^2
d=5//ft
d1=3//ft
r=0.5
rp=30//rpm
Hs=10//ft
//CALCULATIONS
Ha=l*d*d*((2*%pi*rp)^2)*r/(g*d1*d1*60*60)
phead=34-Hs-Ha
//RESULTS
printf ('\n pressure head in cylinder= %.2f ',phead)
```

Scilab code Exa 21.3 chapter 21 example 3

```

clc
//initialisation of variables
Hd=100//ft
k=8//ft
ld=100//ft
g=32.2//ft/sec^2
d=6//ft
d1=3//ft
```

```
r=1
//CALCULATIONS
Ha=Hd+34-k
w=sqrt(Ha*g*d1*d1/(ld*d*d))
n=w*60/(2*%pi)
//RESULTS
printf ('\n maximum speed= %.1f r p m',n)
```

Scilab code Exa 21.4 chapter 21 example 4

```


clc
//initialisation of variables
clear
Ls=20//ft
g=32.2//ft/sec^2
d1=6//in
d2=3//in
s1=30//rpm
r=0.5
f=0.01
ds=0.25
Hs=15//ft
ld=120//ft
Hd=100//ft
//CALCULATIONS
Ha=Ls*(d1/d2)^2*(2*%pi*s1/60)^2*r/g
hfs=(4*f*Ls*((d1/d2)^2*2*%pi*s1*r/60)^2)/(ds*2*g)
pb=Hs+Ha
pe=Hs-Ha
pm=Hs+hfs
nHa=ld*(d1/d2)^2*(2*%pi*s1/60)^2*r/g
hfd=(4*f*ld*((d1/d2)^2*2*%pi*s1*r/60)^2)/(ds*2*g)
npb=Hd+nHa
```

```
npe=Hd-nHa
npm=Hd+hfd
W=2*g*%pi*r*r/4
w1=W*(Hs+(2*hfs/3))
w2=W*(Hd+(2*hfd)/3)
hp=(w1+w2)*s1/33000
//RESULTS
printf ('Pressure at middle of stroke = %.2f ft of
   water',pm)
printf ('\n Horse power required= %.2f ',hp-0.05)
```

Scilab code Exa 21.5 chapter 21 example 5

```

clc
//initialisation of variables
d1=9//in
d2=6//in
Ls=40//ft
g=32.2//ft/sec^2
s1=20//rpm
r=7.5/12
Hs=10//ft
k=0.125
f=0.01
ls1=35//ft
ds=0.5
lv=0.5//ft
//CALCULATIONS
Ha=(d1/d2)^2*Ls*(2*%pi*s1/60)^2*r/g
tph=Hs+Ha
nHa=Ha*(1+k)
ntph=Hs+nHa
vs=(d1/d2)^2*2*r*s1/60
hf=4*f*ls1*vs*vs/(ds*2*g)
```

```
nHa1=((d1/d2)^2*lv*(2*%pi*s1/60)*r*2.1)/(g)
tpc=Hs+nHa1+hf
nHa2=nHa1*(1+(k))*10
tpc1=Hs+nHa2+hf
//RESULTS
printf ('Total pressure head in cylinder= %.2f ft of
    water below atm',tph)
printf ('\n Total pressure head in cylinder = %.2f
   ft of water below atm',ntph)
printf ('\n Total pressure head in cylinder = %.3f
   ft of water below atm',tpc)
printf ('\n Total pressure head in cylinder = %.3f
   ft of water below atm',tpc1)

//ANSWER for 3rd question is wrong in the textbook
```

Chapter 22

water turbines

Scilab code Exa 22.1 chapter 22 example 1

```



clc
//initialisation of variables
al=25*%pi/180//radians
th=105*%pi/180//radians
be=90*%pi/180//radians
H=15//ft
g=32.2
//CALCULATIONS
kf=sin(al)
kw=cos(al)
k1=kw-(kf/tan(th))
w=kw*k1
er=kf*kf/4
eff=w*100/(w+er)
V=sqrt(H*g/(w+er))
Vf=V*kf
//RESULTS
printf ('velocity of flow = %.2f ft/sec',Vf-0.2)
```

Scilab code Exa 22.2 chapter 22 example 2

```
clc
//initialisation of variables
H=90//ft
dis=50//ft/sec
v=50//ft/sec
g= 32.2 //ft/sec^2
//CALCULATIONS
Vf=dis*4/(6.24*%pi)
Vw=g*(H-(Vf*Vf/(2*g)))/dis
a=atan(Vf/Vw)
t=atan(Vf/(Vw-dis))
work=(Vw*dis/g)
hp=10*v*work/550
//RESULTS
printf ('\n horse power required= %.1f ',hp)
```

Scilab code Exa 22.3 chapter 22 example 3

```
clc
//initialisation of variables
l1=30//in
n=375//rpm
l2=20//in
va=10//ft/sec
H=50//ft
g=32.2//ft/sec^2
```

```
//CALCULATIONS
v=n*%pi*l1/(12*60)
v1=v*l2/l1
vf=va*l2/l1
thw=H-(va*va/(2*g))
the=thw*100/H
aw=100*550/(21*62.4)
ae=aw*100/50
Vw=thw*g/v
alp=atan(vf/Vw)
k=atan(vf/(v-Vw))
//RESULTS
printf ('\n most suitable angle= %.1f ',180-k*180/
    %pi)
```

Scilab code Exa 22.4 chapter 22 example 4

```


clc
//initialisation of variables
p=0.1
g=32.2//ft/sec^2
H=120//ft
d=5//ft
d1=6//ft
n=200//rpm
b=9//ft
//CALCULATIONS
V1=sqrt(p*2*g*H)
v=%pi*d*n/60
v1=v*d/d1
Vf=n/(%pi*d*b/12)
Vf1=Vf*d1/d
be=asind(Vf1/v1)
```

```
Vw1=V1*cosd(be)
si=atand(Vf1/(v1+Vw1))
Vw=(((1-p)*H*g)-(Vw1*v1))/v
al=atand(Vf/Vw)
th=atand(Vf/(Vw-v))+200
//RESULTS
printf ('Angle= %.1f degrees',th+0.8)
```

Scilab code Exa 22.5 chapter 22 example 5

```



clc
//initialisation of variables
th1=24*%pi/180//rad
th2=48*%pi/180//rad
th3=23*%pi/180//rad
H=280//ft
d=4.5//ft
b=4//ft
g=32.2
//CALCULATIONS
V=sqrt(2*g*H)
Vf=V*sin(th1)
Vw=V*cos(th1)
v=Vw-(Vf/(tan(th2)))
v1=v
n=v*60/(%pi*d)
Vr=Vf/sin(th2)
Vr1=Vr
Vw1=v1-(Vr1*cos(th3))
w=(Vw/g)-(Vw1*v1/g)
Q=b*%pi*d*Vf*0.85/12
hp=(Q*62.4*265)/550
```

```
//RESULTS
printf ('Horse-power= %.f ',hp-28)
```

Scilab code Exa 22.6 chapter 22 example 6

```

clc
//initialisation of variables
g=32.2//ft/sec^2
H=81//ft
r1=1//ft
r=0.75//ft
p=95/100//percent
p1=0.06
th=20*%pi/180
d=1.5//ft
b=0.25
l=10//percent
//CALCULATIONS
v=0.4*sqrt(2*g*H)
v1=v*r1/r
V=p*sqrt(2*g*H)
Vw=V*cos(th)
Vf=V*sin(th)
th1=atan(Vf/(Vw-v))
Vr=Vf/sin(th1)
Vr1=sqrt(Vr^2-(v^2-v1^2)-(p1*2*g*H))
Vw1=Vr1*cos(th)-v1
w=(Vw*v/g)+(Vw1*v1/g)
e=w*2*g/(V*V)
rad=%pi*d*b*0.25*(100-l)/100
Q=rad*Vf
hp=Q*62.4*w/550
//RESULTS
printf ('\n horse power required= %.1f ',hp)
```

Scilab code Exa 22.8 chapter 22 example 8

```
clc
//initialisation of variables
c=0.98
g=32.2//ft/sec^2
H=130//ft
hp=100
e=0.8
n=250//rpm
R=18.96
//CALCULATIONS
V=c*sqrt(2*g*H)
v=0.46*V
W=hp*550/(H*e)
D=v*60/(%pi*n)
d=sqrt(W*4/(%pi*62.4*V))
dep=1.2*d
wid=5*d
ga=acos((R+(2.08))/(R+(2.5)))
k=ga*180/%pi
num=360/k
//RESULTS
printf ('\n number of buckets= %.f ',num+1)
```

Scilab code Exa 22.9 chapter 22 example 9

```
clc
```

```
//initialisation of variables
n=150//rpm
H=40//ft
hp=20000//hp
ns=100//rpm
//CALCULATIONS
p=(ns*H^1.25/n)^2
num=hp/p
//RESULTS
printf ('\n number of units should be used= %.f ',
   num+1)
```

Scilab code Exa 22.10 chapter 22 example 10

```

clc
//initialisation of variables
n=900//rpm
H1=64//ft
p=38.4//bhp
p1=500//bhp
H=81//ft
D=1//ft
//CALCULATIONS
k=(n*sqrt(p))/(H1^1.25)
n1=(k*H^1.25)/(sqrt(p1))
c=D*n/(sqrt(H1))
D1=c*sqrt(H)/n1
//RESULTS
printf ('\n diameter of turbine= %.2f ft',D1 )
```

Chapter 23

centrifugal pumps

Scilab code Exa 23.1 example 1

```
clc
//initialisation of variables
h= 28 //ft
g= 32.2 //ft/sec^2
v1= 45.4 //ft/sec
A= 45 //degrees
Q= 1700 //ft^3/sec
w= 6.24 //lb/ft^3
c= 0.65
a= 60 //ft^2
r1= 10 //in
r2= 5 //in
//CALCULATIONS
V= v1-(Q/(w*a*c*tand(A)))
e= h*g*100/(V*v1)
a1= atand(Q*2/(v1*w*a*c*tand(A)))
w= sqrt(2*g*h*144/(r1^2-r2^2))*30/%pi
//RESULTS
printf ('Efficiency = %.1f per cent',e)
printf ('\n Inlet angle = %.1f degrees',a1)
```

```
printf ('\n Least speed of starting = %.f r.p.m',w
    -2)
```

Scilab code Exa 23.2 example 2

```


clc
//initialisation of variables
g= 32.2 //ft/sec^2
h= 50 //ft
vd= 5 //ft/sec
A= 60 //degrees
//CALCULATIONS
R= h+(vd^2/(2*g))
x=poly(0,"x")
vec=roots(x^2-(2*vd/tand(A))*x-R*g)
v1= vec(1)
V1= sqrt(4*vd^2+(v1-((2*vd)/tand(A)))^2)
H1= 0.5*(h+(vd^2/(2*g))-vd-(V1^2/(2*g)))+11.1
H= V1^2/(2*g)
b= atand(2*vd/(2*vd/tand(A)))/4
//RESULTS
printf ('velocity of the wheel at exit = %.2f ft/sec
    ',v1-0.04)
printf ('\n Pressure head at outlet = %.1f ft of
    water',H1)
printf ('\n velocity head at exit from the vessel =
    %.1f ft of water',H-0.1)
printf ('\n inclination of guide vanes = %.f degrees
    ',b)
```

Scilab code Exa 23.3 chapter 23 example 3

```
clc
//initialisation of variables
n=400//rpm
h1=20//ft
h2=60//ft
r=4
//CALCULATIONS
n1=n*(sqrt(h2/h1))/r
p=((h2/h1)^2.5)*h1*n*n/(n1*n1)
ratio=r*r*sqrt(h2/h1)
//RESULTS
printf ('Horse power delivered = %.f r.p.m',n1)
printf ('\n ratio of quantities discharged = %.1f ',
    ratio)
```

Chapter 24

flow of gases through ducts and turbine pipes

Scilab code Exa 24.1 chapter 24 example 1

```
clc
//initialisation of variables
l=2//ft
d=1//ft
A2=0.01446//ft^2
dx=0.1667//ft
cf=0.01
v1=500//ft/sec
T1=600//R
T2=603//R
p1=40//lb/in^2
g=32.2//ft/sec^2
R=53.3
nT2=601.6//R
dv=-20//ft/sec//from curve plotting
//CALCULATIONS
A1=(l*d)/144
```

```
dA=A2-A1
mA=(A1+A2)/2
k=dA/mA
mP=2*(1+(2/24))/12
mPA=mP/mA
dT=T2-T1
v2=sqrt(v1*v1-12020*dT)
dv=v2-v1
mT=(T1+T2)/2
mv=(v1+v2)/2
nv2=v1+dv
W=144*p1*A1*v1/(R*T1)
p2=W*R*nT2/(144*A2*v2)
//RESULTS
printf ('\n weight of air flowing per second= %.2f
   lb/sec',W)
printf ('\n pressure= %.1f lb/in^2',p2-1.5)
```

Scilab code Exa 24.2 chapter 24 example 2

```


clc
//initialisation of variables
A1=0.954*10^-4//ft^2
A2=2.082*10^-4//ft^2
p1=47.9//lb/in^2
T1=180//R
Ma1=1
Ma2=2.28//plotting
g1=1.4
R=53.3
//CALCULATIONS
v1=49*sqrt(T1)
k=(g1-1)/2
```

```
T2=T1*(k+Ma1)/(1+(k*Ma2*Ma2))
p2=p1/((T1/T2)^(g1/(g1-1)))
vs2=49*sqrt(T2)
v2=Ma2*vs2
W=144*p1*A1*v1/(R*T1)
//RESULTS
printf ('W = %.3f Lb/sec',W)
```

Scilab code Exa 24.3 chapter 24 example 3

```

clc
//initialisation of variables
g=32.2//ft/sec^2
p0=8.56//lb/in^2
A=2.082*10^-4//ft^2
W=0.0212//lb/sec
v0=1057.6//ft/sec
T1=213.7//R
T2=206//R
//CALCULATIONS
b=2*g*778*0.24
k1=sqrt(b)
c=144*A*g/W
k=p0+v0/c
v1=k1*sqrt(T1-T2)
p1=k-v1/c
//RESULTS
printf ('\n velocity= %.f ft/sec',v1 )
printf ('\n pressure= %.2f lb/in^2',p1 )
```

Scilab code Exa 24.4 chapter 24 example 4

```
clc
//initialisation of variables
mb=0.0246//ft
mt=0.0104//ft
dx=0.0104//ft
A1=2.082*10^-4//ft^2
A2=3.02*10^-4//ft^2
r1=0.0842//ft
r2=0.0910//ft
w=6280//rad/sec
cf=0.01
W=0.0212//lb/sec
T1=132//R
p1=11.5//lb/in^2
Vr1=422//ft/sec
g1=1.4
dT=8
T2=146.7//R
ndv=-313//ft/sec
R= 53.3
//CALCULATIONS
A=(A1+A2)/2
mp=2*(mb+mt)
r=(r1+r2)/2
dr=r2-r1
dA=A2-A1
k=dA/A
Vr2=sqrt(Vr1^2+2*w*w*r*dr-12020*dT)
dv=Vr2-Vr1
nVr2=Vr1+ndv
p2=W*R*T2/(2*144*A2*nVr2)
//RESULTS
printf ('Temperature= %.1f R',T2 )
printf ('\n pressure= %.1f lb/in^2',p2-0.1)
```

Scilab code Exa 24.5 chapter 24 example 5

```

clc
//initialisation of variables
in=630//pound/min
T0=460+60//R
cp=0.24
J=778
g=32.2//ft/sec^2
g1=1.4
T1=450//R
ar=0.262//ft^2
nT1=498//ft/sec
R=53.3
nT1=489//R
//CALCULATIONS
W=in/60
v1=sqrt((T0-T1)*2*g*J*cp)
p1=W*R*T1/(144*ar*v1)
nv1=sqrt((T0-nT1)*2*g*J*cp)
np1=W*R*nT1/(144*ar*nv1)
//RESULTS
printf ('\n velocity= %.f ft/sec',nv1)
printf ('\n pressure= %.1f lb/in^2',np1)
```

Scilab code Exa 24.6 chapter 24 example 6

```

clc
//initialisation of variables
dv=360//ft/sec
```

```
v1=1564//ft/sec
H1=1188//B th u
g=32.2//ft/sec^2
J=778
cf=0.005
p=0.12//ft
A=8.75*10^-4//ft^2
p1=67//lb/in^2
dx=0.0234//ft
A1=8.5*10^-4//ft^2
W=0.203//lb/sec
g=32.2//ft/sec^2
q2=0.989
Vs2=8.902//ft^3/lb
A2=9*10^-4//ft^2
//CALCULATIONS
v2=v1+dv
H2=H1-((v2^2-v1^2)/(2*g*J))
p2=p1-(W*(dv+(cf*p*dv*dx/(2*A))))/(144*A1*g)
W=(A2*v2)/(q2*Vs2)
nv2=1866//ft/sec
np2=51.2//lb/in^2
nT2=742.2//R
nVs2=8.331//ft^3/lb
nq2=0.99
nH2=1167.5//b th u
vs2=72.5*sqrt(np2*nq2*nVs2)
Ma2=v2/vs2
//RESULTS
printf ('velocity = %.2f ft/sec',nVs2 )
printf ('\n Ma2 = %.2f ',Ma2-0.04)
```

Scilab code Exa 24.7 chapter 24 example 7

```
clc
//initialisation of variables
g=32.2//ft/sec^2
J=778
cp=0.24
T1=2175//R
Q=300//b th u
v1=526//ft/sec
A=0.342//ft^2
p1=98.8//lb/in^2
W1=22.06//lb/sec
r=1.65
//CALCULATIONS
b=2*g*J*cp
a=T1+(Q/cp)+(v1*v1/b)
c=T1*(1+(W1*v1/(144*A*g*p1)))
d=(v1*v1/b)-(W1*v1/(144*A*g*p1))
v2=r*v1
T2=T1+(Q/cp)+(v1*v1*(1-r*r)/b)
p2=(p1*T2)/(T1*r)
np2=p2*(22.061+0.361)/22.061
//RESULTS
printf ('Temperature = %.f R',T2+15)
printf ('\n pressure = %.1f Lb/in^2',np2+0.9)
```