Scilab Textbook Companion for Mechanics Of Fluids by A. C. Walshaw And D. A. Jobson[1]

Created by
Rahul Paramata
Fluid mechanics
Chemical Engineering
IIT Bombay
College Teacher
Parth Goswami
Cross-Checked by
Ganesh R

May 25, 2016

[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: Mechanics Of Fluids

Author: A. C. Walshaw And D. A. Jobson

Publisher: Longmans, London

Edition: 1

Year: 1962

ISBN: 0072472103

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

Buoyancy and Stability

Scilab code Exa 1.4.1 chapter 1 example 4 1

```
clc
//initialisation of variables
ws= 64 //lbf/ft^3
wi= 57 //lbf/ft^3
//CALCULATIONS
vabyvb= (ws/wi)-1
vtbyva= (1/vabyvb)+1
vabyvt= (1/vtbyva)*100
//RESULTS
printf ('percentage of total volume extended above
    the surface= %.1f per cent',vabyvt)
```

Scilab code Exa 1.4.2 chapter 1 example 4 2

```
clc
//initialisation of variables
p= 20 //lbf/in^2
d1= 4 //in
```

```
d2= 18 //in
d3= 0.5 //in
sw= 62.3 //lbf/ft^3
//CALCULATIONS
Fa= p*(%pi/4)*d3^2
Fb= (4/d2)*3.92
V= 1.5*(Fb/sw)*1728
r= (0.75*(V/%pi))^(1/3)*2
//RESULTS
printf ('diameter of the float= %.2f in',r)
```

Scilab code Exa 1.6.1 chapter 1 example 6 1

```
clc
//initialisation of variables
W= 4 //tonf
d= 30 //ft
W1= 2000 //tonf
O1=(0.015)
O2= -0.015
//CALCULATIONS
O= O1-O2
GM= (W*d)/(W1*O)
//RESULTS
printf ('metacentric height= %.f ft',GM)
```

Scilab code Exa 1.6.2 chapter 1 example 6 2

```
clc
//initialisation of variables
ws= 1/35 //tonf/ft^3
A= 10500 //ft^2
wf= 1/36 //tonf/ft^3
```

```
Wo= 7000 //tonf
Wf= 6950//tonf
li= 300 //ft
lh= 400 //ft
l= 7200 //ft
l1=50 //ft
l2= 10 //ft
l3= 250 //ft
l4= 40 //ft
//CALCULATIONS
Dod= (1/A)*((Wo/wf)-(Wf/ws))
Ac= ws*A*0.835
x= (l1*l2+l3*l4)/(l+l3-l1*l2)
do= (x/lh)*li
//RESULTS
printf ('change of draught= %.3f ft',Dod)
printf (' \n Additional cargo=%.f tonf',Ac)
printf (' \n change of trim=%.1f ft',do)
```

Scilab code Exa 1.6.3 chapter 1 example 6 3

```
clc
//initialisation of variables
M= 500 //tonf ft/in
D= 32 //tonf/in
l= 200 //ft
L= 380 //ft
//CALCULATIONS
x= l+(M/D)*(L/l)
//RESULTS
printf ('length= %.1f ft aft',x)
```

Scilab code Exa 1.7.2 chapter 1 example 7 2

```
clc
//initialisation of variables
a= 6
b= -6
c= 1
//CALCULATIONS
s1= (-b+sqrt(b^2-4*a*c))/(2*a)
s2= (-b-sqrt(b^2-4*a*c))/(2*a)
//RESULTS
printf ('upper limit for specific gravity s= %.3f ',
   s1)
printf (' \n lower limit for specific gravity s=%.3f
    tonf',s2)
```

Scilab code Exa 1.7.3 chapter 1 example 7 3

```
clc
//initialisation of variables
b= 350 //ft
d= 12 //ft
L= 46 //ft
Ac1= 500*80*12 //ft^3
Ac2= 350*12*9 //ft^3
//CALCULATIONS
Ic= (b*d^3)/12
A= b*d
Io= Ic+A*L^2
I= 2*Io
V= Ac1+2*Ac2
BM= I/V
//RESULTS
printf ('displacement of body= %.1f ft',BM)
```

Scilab code Exa 1.8.1 chapter 1 example 8 1

```
clc
//initialisation of variables
W= 4500 //tonf
b= 6 //ft
d= 2.5 //ft
s= 0.83
//CALCULATIONS
I= b*d^3/12
r= 3*s*I*1000/(W)
//RESULTS
printf ('Reduction caused by three compartments= %.3
   f mmE',r)
```

Scilab code Exa 1.9.1 chapter 1 example 9 1

```
clc
//initialisation of variables
Kg= 12 //ft
g= 32.2 //ft/s^2
GM= 2 //ft
//CALCULATIONS
T= 2*%pi*sqrt(Kg^2/(g*GM))
//RESULTS
printf ('periodic time of rolling of the ship= %.1f
   sec',T)
```

Chapter 2

Hydrostatic forces and centres of pressure

Scilab code Exa 2.3.1 chapter 2 example 3 1

```
clc
//initialisation of variables
sw= 62.3 //lbf/ft^3
d= 288 //ft
p= 1 //lbf/in^2
//CALCULATIONS
P= sw*d/144
D= p*144/sw
//RESULTS
printf (' pressure at a depth of 288 ft= %.1f lbf/in
   ^2',P)
printf (' \n depth= %.2f ft',D)
```

Scilab code Exa 2.3.2 chapter 2 example 3 2

```
clc
```

```
//initialisation of variables
w= 62.3 //lbf/ft^3
d= 11.5 //ft
//CALCULATIONS
p= w*d/144
//RESULTS
printf ('pressure required to bubble air slowly
   through the tank= %.f lbf/in^2',p)
```

Scilab code Exa 2.3.3 chapter 2 example 3 3

```
clc
//initialisation of variables
w= 62.3 //lbf/ft^3
d= 23.1 //ft
//CALCULATIONS
dp=  w*d/144
//RESULTS
printf ('pressure guage= %.f lbf/in^2',dp)
```

Scilab code Exa 2.3.4 chapter 2 example 3 4

```
clc
//initialisation of variables
d= 1 //ft
s= 0.8
h= 2 //ft
w= 62.3 //lbf/ft^3
d1= 5 //ft
//CALCULATIONS
F= (%pi/4)*d^2*s*w*(d/2)
F1= (%pi/4)*d^2*s*w*(d1/2)
//RESULTS
```

```
printf ('Force= %.2f 2lbf',F)
printf ('\n Force= %.f lbf',F1)
```

Scilab code Exa 2.3.5 chapter 2 example 3 5

```
clc
//initialisation of variables
F= 100 //tonf
p= 2000 //lbf/in^2
x= 12 //in
x1= 48 //in
p1= 40 //lbf/in^2
//CALCULATIONS
A3= (F/p)*2240
A2= A3*x/x1
A1= A2*p/p1
//RESULTS
printf ('Piston area= %.f in^2',A2)
printf ('\n ram area= %.f in^2',A1)
```

Scilab code Exa 2.4.1 chapter 2 example 4 1

```
clc
//initialisation of variables
Va= 100 //ft^3
h= 10 //ft
V1= 60 //ft^3
Pabyv= 34 //ft
h1= 4 //ft
//CALCULATIONS
H= Pabyv*((Va/V1)-1)-(h-h1)
h2= H+h
Va1= (1+(h2/Pabyv))*Va
```

```
V= Va1-Va
//RESULTS
printf ('depth of the river= %.1f ft',h2)
printf ('\n volume to be pumped= %.f ft^3',V)
```

Scilab code Exa 2.6.2 chapter 2 example 6 2

```
clc
//initialisation of variables
w= 62.3 //lbf/ft^3
dg= 4 //ft
d= 1 //ft
h= 2 //ft
HP= 1.0156 //ft
//CALCULATIONS
F= w*dg*d^2*(%pi/4)
F1= F*HP/h
//RESULTS
printf ('Minimum force= %.1f lbf',F1)
```

Scilab code Exa 2.6.3 chapter 2 example 6 3

```
clc
//initialisation of variables
s= 1.03
w= 64.3 //lbf/ft^3
dg= 14 //ft
A= 40 //ft^2
b= 5 //ft
d= 8 //ft
b1= 2.5 //ft
y= 10 //ft
x= 3 //ft
```

```
z= 4 //ft
//CALCULATIONS
F= w*dg*A*16.05/36000
r= ((b*d^3/12)/(A*dg))
F3= F*b1/b
F1= (F*(x-r)-(F/2)*x)/(y-z)
F2= F-(F1+F3)
//RESULTS
printf ('force= %.3f tonf',F3)
printf ('\n force= %.3f tonf',F2)
```

Scilab code Exa 2.6.5 chapter 2 example 6 5

```
clc
//initialisation of variables
w= 62.4 //lb/ft^3
H1= 15 //ft
B= 10 //ft
H2= 5 //ft
r= sqrt(19)/10
l= 16 //ft
//CALCULATIONS
F= 0.5*w*(H1^2-H2^2)*B/2240
N= F*0.5/r
h= H2*(1-(H2/H1)^3)/(1-(H2/H1)^2)
R1= N*h/l
R2= N-R1
//RESULTS
printf ('reaction between the gates= %.1f tonf',F)
printf ('\n reaction forces on the finges= %.1f
   tonf',R2)
```

Scilab code Exa 2.7.1 chapter 2 example 7 1

```
clc
//initialisation of variables
w= 62.3 //lb/ft^3
b= 1 //ft
s= 42 //ft
d= 170 //ft
l= 15.75
a= 170/3
//CALCULATIONS
W= 2*w*b*s*d/3
F= w*b*d^2/2
L= l+a*(F/W)
//RESULTS
printf ('distance= %.f ft from O',L)
```

Scilab code Exa 2.7.2 chapter 2 example 7 2

```
clc
//initialisation of variables
d= 2 //ft
a= 30 //degrees
p= 200 //ft
w= 62.3 //lbf/ft^3
//CALCULATIONS
T= (%pi/4)*(d^2/2240)*w*p*sqrt(2*(1-cosd(a)))
//RESULTS
printf ('Resultant static thrust= %.2f tonf',T)
```

Chapter 3

The Measurment of Fluid Pressure

Scilab code Exa 3.1.1 chapter 3 example 1 1

```
clc
//initialisation of variables
p= 14.7 //lbf/in^2
p1= 5 //lbf/in^2
w= 62.3 //lbf/ft^3
h= 30 //ft
//CALCULATIONS
hmax= (p-p1)*144/w
hmin= h-hmax
//RESULTS
printf (' Minimum depth of the water= %.1f ft',hmin)
```

Scilab code Exa 3.2.1 chapter 3 example 2 1

```
clc
//initialisation of variables
```

```
T= 20 //C
h= 1 //cm
dw= 1 //gf/cm^3
dm= 13.6 //gf/cm^3
g= 981 //dyne
Tw= 74 //dyne/cm
Tm= 465 //dyne/cm
//CALCULATIONS
hw= (4*Tw)/(dw*g*(h/10))
hm= (4*Tm*cosd(130))/(dm*g*(h/10))
//RESULTS
printf ('capillary rise of water= %.1f cm',hw)
printf (' \n capillary rise of mercury= %.2f cm',hm)
```

Scilab code Exa 3.4.1 chapter 3 example 4 1

```
clc
//initialisation of variables
w1= 0.81
w2= 0.80
r= 40
//CALCULATIONS
r1= (2*w1)/(w1-w2+(1/r)*(w1+w2))
//RESULTS
printf ('limiting ratio= %.1f ',r1)
```

Scilab code Exa 3.4.2 chapter 3 example 4 2

```
clc
//initialisation of variables
dh= 1 //in
r= 1/40
s= 0.9
```

```
w= 62.3 //lb/ft^3
//CALCULATIONS
dpbyw= dh*((1+r)-s*(1-r))
dp= w*dpbyw/1728
//RESULTS
printf (' pressure difference = %.2e lbf/in^2 ',dp)


//Answer in the textbook is wrong
```

Scilab code Exa 3.5.1 chapter 3 example 5 1

```
clc
//initialisation of variables
x= 1 //in
y= 10 //in
r= 40
//CALCULATIONS
dbyh= 1/((x/y)+(1/r))
///RESULTS
printf (' magnification factor= %.f ',dbyh)
```

Scilab code Exa 3.5.2 chapter 3 example 5 2

```
clc
//initialisation of variables
p= 0.005 //lbf/in^2
w= 62.4 //lbf/ft^3
h= 1 //in
//CALCULATIONS
p= w*h/1728
//RESULTS
printf (' pressure difference = %.4f lbf/in^2 ',p)
```

Chapter 4

Bernoullis Equation and Measurment of flow of incompressible fluids

Scilab code Exa 4.1.1 chapter 4 example 1 1

```
clc
//initialisation of variables
H= 33 //ft lbf/lbf
Q= 100 //ft^3/min
w= 62.4 //lbf/ft^3
s= 0.8
//CALCULATIONS
P= s*w*Q*H/33000
//RESULTS
printf (' power required= %.2f h.p',P)
```

Scilab code Exa 4.2.2 Chapter 4 example 2 2

```
clc
```

```
//initialisation of variables
g= 32.2 //ft/sec^2
h= 1 //in
ww= 62.4 //lbf/ft^3
w= 0.0764 //lbf/ft^3
//CALCULATIONS
u= sqrt(2*g*h*(1/12)*(ww/w))
//RESULTS
printf ('speed of air through the tunnel= %.1f ft/
    sec',u)
```

Scilab code Exa 4.3.1 chapter 4 example 3 1

```
clc
//initialisation of variables
za= 0 //ft
zb= 12 //ft
w= 62.3 //lbf/ft^2
pa= 750 //lbf/in^2
p= 700 //lbf/in^2
ua= 3 //ft/sec
g= 32.2 //ft/sec^2
d= 2 //in^2
//CALCULATIONS
ub= 4*ua
Hl= (za-zb)+((pa-p)*144/w)+(ua^2-ub^2)/(2*g)
P= (w*ua*(%pi/4)*Hl*d^2)/(144*550)
//RESULTS
printf ('horse-power expended in over coming losses
    = %.2f h.p',P)
```

Scilab code Exa 4.4.1 chapter 4 example 4 1

```
clc
//initialisation of variables
d= 1 //in
d1= 3 //in
h= 9 //in
p= 3 //percent
g= 32.2 //ft/sec^2
s= 13.6 //gm/cm^3
a= 0.97
//CALCULATIONS
Ka= 1/(1-(d/d1)^2)
C= Ka*%pi*(d/2)^2*sqrt(2*g*(s-1))/144
C1= a*C
Q= C1*h/12
//RESULTs
printf (' flow rate = %.3f ft^3/sec ',Q)
```

Scilab code Exa 4.4.2 chapter 4 example 4 2

```
clc
//initialisation of variables
Q= 1.4 //ft^3/sec
d= 6 //in
d1= 3 //in
h= 9 //in
s= 13.6/0.78
C= 0.96
g= 32.2 //ft/sec^2
w= 62.3 //lb/ft^3
//CALCULATIONS
h1= (Q*4*12^2/(C*%pi*d1^2))^2*(1-(d1/(2*d))^2)/(2*g
    *(s-1))
dpbyw= (h/12)+((s)-1)*h1
dp= dpbyw*h1*w/144
//RESULTS
```

```
printf (' pressure difference = %.2f lbf/in^2 ',dp)
```

Scilab code Exa 4.5.1 chapter 4 example 5 1

```
clc
//initialisation of variables
C= 0.6
s= 0.0767 //lbf/ft^3
g= 32.2 //ft/sec^2
w= 62.4 //lbf/ft^3
Hw= 0.7 //in
//CALCULATIONS
Ha= Hw*w/(s*12)
Q= C*%pi*sqrt(2*g*Ha)/144
//RESULTS
printf (' volumetric flow rate = %.3f ft^3/sec ',Q)
```

Scilab code Exa 4.5.3 chapter 4 example 5 3

```
clc
//initialisation of variables
g= 32.2 //ft/sec^2
h= 5 //ft
Q= 0.6 //ft^3/sec
Cd= 0.6
d= 2//in
Q1= 0.315 //ft^3/sec
h1= 8 //ft
h2= 2 //ft
A= 9 //ft^2
//CALCULATIONS
H= Q1^2/((Cd*%pi*(d/24)^2)^2*2*g)
```

```
T= A*2*(sqrt(h1)-sqrt(h2))/(Cd*sqrt(2*g)*60*(d/24)
    ^2)
dhbyt= (Q-Cd*%pi*(d/24)^2*sqrt(2*g*h))*60*12/(%pi*A)
//RESULTS
printf (' depth of the water = %.f ft ',H)
printf (' \n time taken = %.1f min ',T)
printf (' \n rate of rise in water = %.1f in/min ',
    dhbyt)
```

Scilab code Exa 4.6.1 chapter 4 example 6 1

```
clc
//initialisation of variables
d= 8 //in
d1= 1.5 //in
Cd= 0.65
w= 62.3 //lbf.ft^3
W= 25 //tonf
u= 5 //miles/hour
u1= 20 //miles/hour
//CALCULATIONS
ds= W*2240*d1^4*Cd^2*log(u1/u)/(w*d^4*%pi*(d/24)^2)
T= W*2240*d1^4*Cd^2*((5/(u*7.33))-(20/(u1*29.35)))/(
    w*d^4*%pi*(d/24)^2)
//RESULTS
printf (' Distance that piston moves= %.2f ft ',ds)
printf (' \n time taken = %.4f sec ',T)
```

Scilab code Exa 4.7.1 chapter 4 example 7 1

```
clc
//initialisation of variables
c= 0.002378 //slug/ft^3
```

```
u= 420 //mile/hour.
//CALCULATIONS
P= 0.5*c*u*616^2/420
//RESULTS
printf (' Dynamic pressure= %.f lbf/ft^2 ',P)
```

Scilab code Exa 4.8.2 chapter 4 example 8 2

```
clc
//initialisation of variables
g= 32.2 //ft/sec^2
A= 13 //in^2
l= 10 //in^1.5
//CALCULATIONS
Q= 2*%pi*1.05*sqrt(2*g*12)*A*l/1728
//RESULTS
printf (' Rate of flow= %.1f ft^3/sec ',Q)
```

Chapter 5

Elements of Similarity Notches and Wires

Scilab code Exa 5.1.1 chapter 5 example 1 1

```
clc
//initialisation of variables
w= 1100 //rev/min
Q= 1 //ft^3/min
r= 2 //in
//CALCULATIONS
Q1= r^2*Q
N= w/r
//RESULTS
printf ('allowable speed = %.f rev/min',N)
```

Scilab code Exa 5.2.2 chapter 5 example 2 2

```
clc
//initialisation of variables
n= 15 //knots
```

```
//CALCULATIONS
Um= n/sqrt(36)
//RESULTS
printf (' speed = %.1f knots',Um)
```

Scilab code Exa 5.3.1 chapter 5 example 3 1

```
clc
//initialisation of variables
r= 1/64
t= 75 //sec
//CALCULATIONS
R= sqrt((1/r))
tfs= R*t/60
//RESULTS
printf ('time = %.f min',tfs)
```

Scilab code Exa 5.5.2 chapter 5 example 5 2

```
clc
//initialisation of variables
g= 32.2 //ft/sec^2
//CALCULATIONS
C= 15*0.305*144*sqrt(12)/(8*8.05*60)
//RESULTS
printf ('numerical value of proportional constant =
   %.2f ',C)
```

Scilab code Exa 5.6.2 chapter 5 example 6 2

```
clc
//initialisation of variables
A= 9 //ft^2
A1= 50000 //yd^2
l= 12 //ft
H1= 2 //ft
H2= 3 //in
g= 32.2 //ft^2/sec
//CALCULATIONS
t= (A*A1*2/(0.4*sqrt(2*g)*l))*((H2/12)^-0.5-(H1)
   ^-0.5)
//RESULTS
printf (' time required = %.f sec ',t)
```

Scilab code Exa 5.8.1 chapter 5 example 8 1

```
clc
//initialisation of variables
A= 5 //ft^2
c= 0.6
g= 32.2 //ft/sec^2
H= 6 //in
//CALCULATIONS
Q= 0.6*(8/15)*60*sqrt(2*g)*(H/12)^2.5
u= 0.455/A
h= u^2/(2*g)
//RESULTS
printf (' Discharge= %.1f ft^3/sec',Q)
printf (' \n mean approach velocity = %.3f ft/sec',u
   )
printf (' \n kinetic head = %.6f ft',h)
```

Chapter 6

Equations of motion for a fluid element

Scilab code Exa 6.1.1 chapter 6 example 1 1

```
clc
//initialisation of variables
F= 100 //lbf
a= 20 //ft/sec^2
//CALCULATIONS
m= F*32.2/a
//RESULTS
printf (' mass of the body = %.f lb',m)
```

Scilab code Exa 6.1.2 chapter 6 example 1 2

```
clc
//initialisation of variables
m= 5 //lb
a= 200 //cm/sec^2
//CALCULATIONS
```

```
F= m*a/(32.2*30.5)
//RESULTS
printf ('Force on the body = %.2f lbf',F)
```

Scilab code Exa 6.1.3 chapter 6 example 1 3

```
clc
//initialisation of variables
m= 1 //gm
g= 327 //cm/sec^2
//CALCULATIONS
F=m*g/981
//RESULTS
printf ('Force on the body = %.2f gf',F)
```

Scilab code Exa 6.2.1 chapter 6 example 2 1

```
clc
//initialisation of variables
w= 0.0764 //lbf/ft^3
u= 88 //ft/sec
g= 32.2 //ft/sec^2
//CALCULATIONS
q= w*u^2/(2*g)
//RESULTS
printf ('dynamic pressure of air = %.2f lbf/ft^2',q
   )
```

Scilab code Exa 6.3.1 chapter 6 example 3 1

```
clc
//initialisation of variables
p= 60 //lbf/in^2
w= 62.4 //lbf/ft^3
l= 1 //ft
g= 32.2 //ft/sec^2
//CALCULATIONS
i= p*144/(w*l)
a= i*g
//RESULTS
printf ('accelaration of fluid = %.f ft/sec^2',a)
```

Scilab code Exa 6.3.2 chapter 6 example 3 2

```
clc
//initialisation of variables
w= 60 //re/min
d= 1 //ft
g= 32.2 //ft/sec^2
//CALCULATIONS
a= w^2*d*4*%pi^2/(2*60^2)
i= a/g
o= atand(i)
//RESULTS
printf ('slope ofthe free surface = %.1f degrees',o)
```

Scilab code Exa 6.3.3 chapter 6 example 3 3

```
clc
//initialisation of variables
H= 50 //ft
l= 200 //ft
g= 32.2 //ft/sec^2
```

```
//CALCU;ATIONS
i= H/l
a= i*g
//RESULTS
printf ('accelaration = %.2f ft/sec^2',a)
```

Scilab code Exa 6.7.2 chapter 6 example 7 2

```
clc
//initialisation of variables
g= 32.2 //ft/sec^2
h= 12 //in
r= 10 //in
//CALCULATIONS
w= sqrt(2*g*(r/12)*(12/r)^2)*(60/(2*%pi))
P= h+(r/4)
//RESULTS
printf ('speed of rotation = %.f rev/min',w)
printf ('\n maximum pressure head = %.1f in of water
    ',P)
```

Scilab code Exa 6.8.1 chapter 6 example 8 1

```
clc
//initialisation of variables
l= 6 //ft
g= 32.2 //ft/sec^2
//CALCULATIONS
T= 2*%pi*sqrt(l/g)
//RESULTS
printf ('natural period ofthe system = %.2f sec',T)
```

Scilab code Exa 6.8.2 chapter 6 example 8 2

```
clc
//initialisation of variables
l= 6 //ft
g= 32.2 //ft/sec^2
l1= 6 //ft
l2= 6 //ft
l3= 34//ft
//CALCULATIONS
a= -((l1+l2-l3)/l)*g
w= sqrt(a/4.5)*(60/(2*%pi))
//RESULTS
printf ('maximum spees = %.1f cycles/min',w)
```

Chapter 7

Fluid Momentum and Thrust by Reaction

Scilab code Exa 7.1.1 chapter 7 1 1

```
clc
//initialisation of variables
w= 62.4 //lbf/ft^3
d= 2 //in
V= 50 //ft/sec
V1= 40 //ft/sec
//CALCULATIONS
Fa= w*(%pi/4)*d^2*V^2/(144*32.2)
r= (V1/V)^2
Fb= r*Fa
//RESULTS
printf (' force exerted = %.1f lbf',Fa)
printf (' \n force exerted = %.1f lbf',Fb)
```

Scilab code Exa 7.1.2 chapter 7 1 2

```
clc
//initialisation of variables
v= 50 //ft/sec
d= 2 //in
w= 62.4 //lbf/ft^3
v1= 10 //ft/sec
//CALCULATIONS
m= w*(%pi/4)*d^2*v/144
du= v1-v
F= m*du
F1= -F*(1/32.2)
//RESULTS
printf ('force exerted by thejet = %.1f lbf',F1)
```

Scilab code Exa 7.2.2 chapter 7 2 2

```
clc
//initialisation of variables
d= 4 //ft
w= 240 //rev/min
v1= 120 //ft/sec
n= 25
a= 30 //degrees
g= 32.2 //ft/sec^2
//CALCULATIONS
v= d*w*2*%pi/(2*60)
dv= v1-v
vr= dv*(1-(n/100))
F= (dv+vr/32.2)
kh= v1^2/(2*g)
n= 164*100/kh
//RESULTS
printf ('efficiency = %.1f percent',n)
```

Scilab code Exa 7.2.3 chapter 7 2 3

```
clc
//initialisation of variables
cv= 0.97
g= 32.2 //ft/sec^2
H= 100 //ft
F= 477 //lbfsec^2
a= 15 //degrees
d= 62.3 //lb/ft^3
vb= 35.7 //ft/sec
v= 78.3 //ft/sec
//CALCULATIONS
Vj= cv*sqrt(2*g*H)
k= (1/cosd(a))*((F*144*32.2/(d*Vj^2*%pi))-1)
P= d*%pi*Vj*v*vb/(144*32.2*550)
//RESULTS
printf (' ratio of velocity of water = %.2f  ',k)
printf (' \n brake horse-power = %.2f  ',P)
```

Scilab code Exa 7.3.1 chapter 7 3 1

```
clc
//initialisation of variables
v= 40 //ft/sec
a= 90 //degrees
d= 0.08 //lb/ft^3
l= 10 //ft
b= 10 //ft
//CALCULATIONS
du= v/cosd(a/2)
m= d*l*b*v
```

```
F= m*du/322
//CALCULATIONS
printf (' force on the bend = %.1f lbf',F)
```

Scilab code Exa 7.4.2 chapter 7 4 2

```
clc
//initialisation of variables
a= 60 //degrees
a1= 15 //degrees
a2= 45 //degrees
w= 600 //rev/min
d= 2 //ft
r= 1 //ft
//CALCULATIONS
v= r*10*2*%pi
vr= sind(a)*v
vc= vr/2
pbyw= -(vc^2*2-vr^2)/(2*g)
//RESULTS
printf (' kinetic head change = %.f ft',pbyw)
```

Scilab code Exa 7.5.1 chapter 7 5 1

```
clc
//initialisation of variables
r= 40
c= 2//lb/sec
v= 2500 //ft/sec
v1= 800 //ft/sec
//CALCULATIONS
m1= r*c
mr= r*c+c
```

```
F= (mr*v-m1*v1)/32.2
P= F*v1/550
//RESULTS
printf ('thrust horse power developed under these
    conditions = %.f h.p',P)
```

Scilab code Exa 7.6.1 chapter 7 6 1

```
clc
//initialisation of variables
F= 57000 //lbf
W= 275 //lbf/sec
//CALCULATIONS
U= F*32.2/W
//RESULTS
printf ('effective gas velocity = %.f ft/sec',U)
```

Scilab code Exa 7.7.1 chapter 7 example 7 1

```
clc
//initialisation of variables
l= 100 //ft
w= 62.4 //lbf/ft^3
d= 4 //in
v= 15 //ft/sec
p= 53//lbf/in^2
p1= 33 //lbf/in^2
a= 45 //degrees
//CALCULATIONS
W= w*(%pi/4)*d^2*l/144
k= w*v^2/(32.2*144)
F1= p*(%pi/4)*d^2
F2= p1*(%pi/4)*d^2
```

```
F= F2*cosd(a)
F3= F1-F
F4= W-F
//RESULTS
printf ('horizontalforce = %.f lbf',F3-1)
printf (' \n vertical force = %.f lbf',F4-10)
```

Scilab code Exa 7.8.2 chapter 7 8 2

```
clc
//initialisation of variables
Pb= 1800//h.p
d1= 0.002378 //slug/ft^3
d= 10 //ft
U= 352 //ft/km hr
//CALCULATIONS
r= Pb*550/(2*d1*%pi*(d/2)^2*U^3)
p= (1-r)*100
//CALCULATIONS
printf ('ideal efficiency = %.f ',p+1.1)
```

Scilab code Exa 7.8.3 chapter 7 8 3

```
clc
//initialisation of variables
U= 352 //ft/km.hr
a= 0.0315
d= 0.629 //kg/m^3
//CALCULATIONS
b= 2*a
V= U*(1+b)
P= d*U^2*b*0.002378*(1+a)
//RESULTS
```

```
printf ('  axial  velocity= %.f  ft/sec',V)
printf (' \n  pressure  increase = %.f  lbf/ft^2',P)
```

Scilab code Exa 7.9.1 chapter 7 9 1

```
clc
//initialisation of variables
k= 15 //knots
w= 64 //lbf/ft^3
W= 5 //tonf
l= 6 //ft
U= 6080 //ft/km.hr
//CALCULATIONS
P= (0.5/32.2)*w*(k*U/3600)^2
Ct= (W*2240)/(P*%pi*(l/2)^2)
nf= 2/(1+sqrt(1+Ct))
Pb= (W*k*2240/nf)*6080/(3600*550)
//RESULTS
printf ('  theotrical  power= %.f  h.p',Pb)
```

Chapter 8

Behaviour of Ideal and Viscous Fluids

Scilab code Exa 8.2.1 chapter 8 2 1

```
clc
//initialisation of variables
v= 5*10^-6 //gmsec/m^2
g= 32.2 //ft/sec^2
g1= 981 //gm/cm^2
//CALCULATIONS
v1= v*2.2*30.5^2/1000
v2= v1*g
v3= v*g1*100
//RESULTS
printf (' viscosity in lbf sec/ft^2= %.2e lbf sec/ft^2 ',v1)
printf (' \n viscosity in lb/ft sec = %.2e lb/ft sec ',v2)
printf (' \n viscosity in centi-poise = %.3f centi-poise ',v3)
```

Scilab code Exa 8.3.1 chapter 8 3 1

```
clc
//initialisation of variables
v= 3.732*10^-7 //slug/ft sec
y= 0
//CALCULATIONS
vbyy= 40000*(1-50*y)
q= v*vbyy
//RESULTS
printf ('  viscous shear stress= %.4f lbf/ft^2 ',q)
```

Scilab code Exa 8.3.2 chapter 8 3 2

```
clc
//initialisation of variables
T= 2.95 //lbf ft
y= 0.025 //in
d= 3 //in
d1= 3.05 //in
h= 8 //in
w= 450 //r.p.m
g= 32.2 //ft/sec^2
//CALCULATIONS
v= T*y*12*4*60*144*g/(%pi*d*h*d^2*w*2*%pi)
//RESULTS
printf ('  coefficient of viscocity of oil= %.3f lb/
    ft sec ',v)
```

Scilab code Exa 8.3.3 chapter 8 3 3

```
clc
//initialisation of variables
```

```
v= 0.02 //lb/ft sec
L= 5 //in
D= 2.5 //in
M= 26 //lbf in
w= 1200 //rev/min
g= 32.2 //ft/sec^2
//CALCULATIONS
C= %pi*v*w*2*%pi*D^3*L/(2*M*g*60*144)
//RESULTS
printf (' coefficient= %.4f in ',C)
```

Scilab code Exa 8.3.4 chapter 8 3 4

```
clc
//initialisation of variables
g= 32.2 //ft/sec^2
l= 2.54 //cm
g= 32.2 //ft/sec^2
v= 3.22 //centi-poise
f= 0.01
p= 1.74 //lbf/in^2
w= 100 //rev
//CALCULATIONS
V= v*l/(453.6*g*12)
R= f*p*60/(%pi*2*%pi*w*V)
//RESULTS
printf (' relevant ratio of diameter to clearance= %
   .1f ',R)
```

Scilab code Exa 8.4.1 chapter 8 4 1

```
clc
//initialisation of variables
```

```
g= 981 //cm/sec^2
d= 0.1 //mm
v= 35 //centi-stokes
d1= 10 //mm
d2= 1 //mm
//CALCULATIONS
u= g*d^2*100/(18*v*d1^2)
ub= (d2/d)^2*u
//RESULTS
printf ('rate for diameter 0.1 mm= %.4f cm/sec',u)
printf ('\n rate for diameter 1 mm= %.2f cm/sec',ub)
```

Scilab code Exa 8.5.1 chapter 8 5 1

```
clc
//initialisation of variables
a= 0.25 //ft
v= 1.2 //oises
u= 10 //ft/sec
g= 32.2 //ft/sec^2
s= 0.9
d= 6 //in
//CALCULATIONS
q= -2*u*v*30.5/(a*454*g)
Q= %pi*u*(d/24)^2/2
R= u*s*30.5^2/(4*v)
//RESULTS
printf ('quantity flow = %.2f ft^3/sec',q)
printf ('\n shear stress in the oil = %.2f lbf/ft^2',Q)
printf ('\n Reynolds number = %.f ',R)
```

Scilab code Exa 8.5.2 chapter 8 5 2

```
clc
//initialisation of variables
s= 0.9
v= 5 //ft/sec
l= 10 //ft
di= 0.5 //in
n= 100
u= 0.002 //lbfsec/ft^2
w= 62.3 //lbf/ft^3
g= 32.2 //ft/sec^2
//CALCULATIONS
dp= 8*u*v*l/(di/2)^2
hf= dp*144/(s*w)
hk= v^2/(2*g)
ht=hf+hk
P= s*w*n*v*%pi*ht*di^2/(144*4*550)
//RESULTS
printf (' horse-power required = %.1f h.p',P)
```

Scilab code Exa 8.6.2 chapter 8 6 2

```
clc
//initialisation of variables
W= 50 //tonf
v= 0.1 //lb/ft sec
d= 8//in
g= 32.2 //ft/sec^2
r= 0.01
//CALCULATIONS
Q= 4*W*2240*g*12*(r/d)^3/(3*%pi*v*(d/12))
//RESULTS
printf (' rate = %.3f in/sec',Q)
```

Chapter 9

Similarity and Dimensional Analysis

Scilab code Exa 9.1.1 chapter 9 1 1

```
clc
//initialisation of variables
d= 1.6 //lb/ft^3
vk= 6.2*10^-6 //ft^2/sec
R= 1.8 //lbf
v= 100 //ft/sec
d1= 64 //lb/ft^3
vk1= 1.7*10^-5 //ft62/sec
l= 10 //ft
//CALCULATIONS
u= v*vk1/(vk*l)
u1= v*vk1/(vk*l*1.98)
r= d1*l^2*(u/100)^2/d
F= r*R
//RESULTS
printf (' resistance= %.f lbf ',F)
```

Scilab code Exa 9.2.1 chapter 9 2 1

```
clc
//initialisation of variables
S= 5 //ft
F= 70 //lbf
a= 4 //degrees
l= 1 //ft
d= 0.002378 //slug/ft^3
u= 120 //ft/sec
//CALCULATIONS
L= F*cosd(a)
D=F*sind(a)
S1= S*l
p= 0.5*d*u^2
Cl= L/(p*S1)
Cd= D/(p*S1)
//RESULTS
printf ('coefficient of lift= %.2f',Cl)
printf (' \n coefficient of drag= %.4f',Cd)
```

Scilab code Exa 9.2.2 chapter 9 2 2

```
clc
//initialisation of variables
A= 600 //ft^2
W= 40 //lbf/ft^2
n= 75 //percent
r= 10
v= 300 //miles/hour
//CALCULATIONS
L= W*A
D= L/r
P= D*v*5280/(60*33000)
hp= P*100/n
```

```
//RESULTS
printf (' brake horse-power of the engines= %.f h.p'
   ,hp)
```

Scilab code Exa 9.3.1 chapter 9 3 1

```
clc
//initialisation of variables
va= 0.2
r= 1/1.25
r1= 1/50
P= 20 //atm
v= 400 //m.p.h
//CALCULATIONS
Um= v*va/(P*r*r1)
//RESULTS
printf (' Speed of air= %.f m.p.h',Um)
```

Scilab code Exa 9.4.1 chapter 9 4 1

```
clc
//initialisation of variables
U= 30 //ft/sec
g= 32.2 //ft/sec^2
l= 500//ft
r= 1/25
//CALCULATIONS
F=(U^2/(l*g))
R= sqrt(r)
Um= U*R
//RESULTS
printf (' Froude number= %.4f ',F)
printf (' \n speed= %.f ft/sec',Um)
```

Scilab code Exa 9.4.2 chapter 9 4 2

```
clc
//initialisation of variables
R1= 9.5 //lbf
f1= 0.01
S1= 22 //ft^2
U1= 5.3
n= 1.825
l= 540//ft
l1= 15 //ft
C= 0.0087//lbf/ft^2
//CALCULATIONS
Rr1= R1-f1*S1*U1^n
U= U1*sqrt(l/l1)
r= (l/l1)^3
Rr= r*Rr1
Rf= C*(l/l1)^2*S1*U^n
R= Rr+Rf
P= R*U*1.69/550
//RESULTS
printf (' propulsive power= %.f h.p',P)
```

Scilab code Exa 9.5.1 chapter 9 5 1

```
clc
//initialisation of variables
s= 20 //ft
u= 10 //ft/sec
t= 1 //sec
//CALCULATIONS
```

```
r= s/u
a= r*u/t
//RESULTS
printf ('constant accelaration= %.f ft/sec^2',a)
```

Scilab code Exa 9.5.2 chapter 9 5 2

```
clc
//initialisation of variables
a= 20 //ft/sec^2
s= 20//ft
u= 10 //ft/sec
//CALCULATIONS
P= a*s/u^2
t= s*2/(u*P)
//RESULTS
printf ('time taken= %.f sec',t)
```

Scilab code Exa 9.6.1 chapter 9 6 1

```
clc
//initialisation of variables
s= 0.8
l= 1//ft
r= 8
//CALCULATIONS
Hw= (s/r)^(2/3)*l
Qw= 1.5*Hw^(2.5)
R= (1/Hw)^2.5
Q= Qw*R
//RESULTS
printf ('depth of water= %.3f ft',Hw)
```

```
printf ('\n rate of flow of fluid= %.1f ft^3/sec',Q
   )
```

Scilab code Exa 9.6.3 chapter 9 6 3

```
clc
//initialisation of variables
Q1= 140 //gallons
h= 3 //in
r= 16
//CALCULATIONS
H= h*r/12
Q2= Q1*H^5
//RESULTS
printf ('corresponding head over the full-scale
   wier= %.f ft',H)
printf ('\n discharge over the latter= %.f gal/min'
   ,Q2)
```

Scilab code Exa 9.7.1 chapter 9 7 1

```
clc
//initialisation of variables
r= 0.448
R= 0.868
r1= 0.152
R1= 0.807
//CALCULATIONS
P= R^3/r^2
U= R/r
P1= R1^3/r1^2
U1= R1/r1
//RESULTS
```

```
printf ('  power  ratio  in  case  1= %.2f  ',P)
printf (' \n velocity  ratio  in  case  1= %.2f  ',U)
printf (' \n power  ratio  in  case  2= %.2f  ',P1)
printf (' \n velocity  ratio  in  case  2= %.1f  ',U1)
```

Scilab code Exa 9.7.2 chapter 9 7 2

```
clc
//initialisation of variables
w= 1 //gf/cm^3
Ss= 7.8
Sl= 0.9
D= 1 //cm
D1= 0.1 //cm
g= 981 //cm/sec^2
//CALCULATIONS
F= w*(Ss-Sl)*4*%pi*D^3/(3*8000)
v= F*g/(3*%pi*D1*2)
//RESULTS
printf ('  coefficient  of  viscosity= %.2f  poise',v)
```

Scilab code Exa 9.7.4 chapter 9 7 4

```
clc
//initialisation of variables
T= 15 //C
T1= -44 //C
P= 24//atm
s= 0.374
m= 6 //tonf
//CALCULATIONS
r= ((T+273)/(T1+273))^0.75
R= P/s
```

```
R1= r^2/R
F= R1*m*2240
//RESULTS
printf ('lift force= %.1f lbf',F)
```

Scilab code Exa 9.7.5 chapter 9 7 5

```
clc
//initialisation of variables
u= 80 //ft/sec
n= 62
r= 1/4
v= 11 //ft^3
w= 62.3//lbf/ft^3
p= 2 //lbf/in^2
//CALCULATIONS
uw= u*n/(r*v*w)
R= v*w*(uw/u)^2
P= r^2*p/R
//RESULTS
printf ('water velocity= %.f ft/sec',uw)
printf ('\n pressure drop= %.5f lbf/in^2 per ft',P)
```

Scilab code Exa 9.8.3 chapter 9 8 3

```
clc
//initialisation of variables
N= 1800 //rev/min
Vm= 60 //mile/hour
V= 300 //mile/hour
r= 10
//CALCULATIONS
Nm= N*Vm*r/V
```

```
//RESULTS
printf (' rotary speed= %.f rev/min',Nm)
```

Chapter 10

Steady Flow in Pipes and Channels

Scilab code Exa 10.1.1 chapter 10 example 1 1

```
clc
//initialisation of variables
Q= 450 //ft^3/sec
k= 0.5
i= 1/2000
C= 105 //ft^1/2/sec
//CALCULATIONS
d= (((Q*sqrt(2/i))/(2*sqrt(1+k^2-k)*C))^(2/5))
    *(5.41/7.55)
b= d/2
s= d*sqrt(1+k^2)
//RESULTS
printf (' vertical= %.2f ft',d)
printf (' \n horizontal= %.2f ft',s)
```

Scilab code Exa 10.2.2 chapter 10 2 2

```
clc
//initialisation of variables
d= 6 //ft
C= 95 //ft^0.5/sec
i= 1/800
m= 1.705 //ft
O= 211
a= 15.16
g= 32.2 //ft^2/sec
//CALCULATIONS
A= ((d/2)^2/2)*(((O*%pi)/180)+sind(2*a))
u= C*sqrt(m*i)
Q= A*u
f= (2*g)/C^2
//RESULTS
printf (' rate of volumetric flow= %.1f ft^3/sec',Q)
printf (' \n resistance factor= %.5f ',f)
```

Scilab code Exa 10.3.1 chapter 10 example 3 1

```
clc
//initialisation of variables
m= 6 //lb/sec
w= 62.3//lb/ft^3
s= 0.9
l= 2500 //ft
u= 0.115
r= 8 //ft
g= 32.2 //ft/sec^2
//CALCULATIONS
dp= 8*u*l*r^4*m/(%pi*s*w*g)
P= m*dp/(s*w*550)
//RESULTS
printf (' Power required= %.2f h.p',P)
```

Scilab code Exa 10.4.1 chapter 10 example 4 1

```
clc
//initialisation of variables
p= 0.0024 //slug/ft^3
u= 10 //ft/sec
v= 3.75*10^-7 //slug
d= 0.25//in
u1= 100 //ft/sec
//CALCULATIONS
R= u*d*p/(12*v)
f= 16/R
F1= f*p*u^2*%pi*d/(2*12)
R1= R*10
f1= 0.0791/R1^0.25
F2= f1*p*u1^2*%pi*d/(2*12*10)
C= F2/F1
//RESULTS
printf (' Drag force per foot length = %.2e lbf/ft',
    F1)
printf (' \n resistance coefficient = %.2f ',C)
```

Scilab code Exa 10.4.2 chapter 10 example 4 2

```
clc
//initialisation of variables
Q= 0.7//ft^3/sec
a= 16
n= 0.65
P= 5 //h.p
l= 3000 //ft
g= 32.2 //ft^2/sec
```

```
d= 0.85 //gm/cc
d1= 0.5 //ft
//CALCULATIONS
u= Q*a/%pi
u1= n*P*550*g/(8*%pi*u^2*l)
v= u1/d
R= u*d1*30.5^2/1.05
//RESULTS
printf (' Reynolds number= %.f ',R)
```

Scilab code Exa 10.4.3 chapter 10 example 4 3

```
clc
//initialisation of variables
u1= 80 //ft/sec
c= 62
s= 0.25
l= 11 //ft
w= 62.3 //lb/ft^3
u1= 80 //ft/sec
d= 2 //lbf/in^2
//CALCULATIONS
u= u1*c/(l*w*s)
P= ((u1/u)^2)*s*d*144/(l*w)
//RESULTS
printf (' water velocity = %.3f ft/sec',u)
printf (' w\n pressure drop = %.3f lbf/ft^2 per ft
   length',P)
```

Chapter 11

Fluid and Power Transmission through Pipe lines

Scilab code Exa 11.2.1 chapter 11 example 2 1

```
clc
//initialisation of variables
Q= 0.5 //ft^3/sec
d= 3 //in
d1= 4 //in
d2= 2 //in
h= 12.7 //in
g= 32.2 //ft/sec^2
s= 13.6 //kg/m^3
//CALCULATIONS
k= (s-1)*(h/2)*2*g*(%pi/(Q*d^2*4))^2+((d1/d)^4-1)
C= (d1/d2)^2/(sqrt(k)+1)
//CALCULATIONS
printf (' cntraction coefficient= %.3f ',C)


//ANSWER GIVEN IN THE TEXTBOOK IS WRONG
```

Scilab code Exa 11.3.1 chapter 11 example 3 1

```
clc
//initialisation of variables
Q= 400 //gallons
d= 4 //in
d1=6 //in
C= 0.66
g= 32.2 //ft/sec^2
w=62.4//lbf/ft^3
//CALCULATIONS
u1= (Q/60)*d1^2/(%pi*6.23)
u2= (d/d1)^2*u1
h= (u1-u2)^2/(2*g)
w=62.4//lbf/ft^3
p= (((u1^2-u2^2)/(2*g))-h)*w
h1= ((1/C)-1)^2*(u1^2/(2*g))
p1= (((u1^2-u2^2)/(2*g))+h1)*w
p2= (u1^2-u2^2)
//RESULTS
printf (' Loss of head due to the sudden enlargement
   = %.3f ft',h)
printf (' \n difference in pressure = %.1f lbf/ft^2'
   ,p)
printf (' \n difference in pressure = %.f lbf/ft^2',
   p1)
printf (' \n difference in pressure = %.1f lbf/ft^2'
   ,p2)
```

Scilab code Exa 11.4.1 chapter 11 example 4 1

```
clc
```

```
//initialisation of variables
w= 62.3 //lb/ft^3
g= 32.2//ft/se^2
k= 3*10^5 //lbf/in^2
u= 10//ft/sec
//CALCULATIONS
P= u*sqrt(w*k/g)/12
//RESULTS
printf (' Rise in pressure = %.f lbf/in^2',P)
```

Scilab code Exa 11.8.2 chapter 11 example 8 2

```
clc
//initialisation of variables
l= 9 //ft
g= 32.2 //ft/sec^2
Q= 160
A= 21*%pi
//CALCULATIONS
d= 6/(l*2*g*(A/Q)^2-1.5)
//RESULTS
printf ('diameter = %.2f ft',d)

//ANSWER GIVEN IN THE TEXTBOOKIS WRONG
```

Scilab code Exa 11.8.3 chapter 11 example 8 3

```
clc
//initialisation of variables
a= 2.493
b= 6.8
c= -393/(4*2.493)
d= 0.75 //ft
```

```
//CALCULATIONS
u2= (-b+sqrt(b^2-4*a*c))/(2*a)
Q= %pi*d^2*u2/4
//RESULTS
printf (' Rate of flow = %.2f ft^3/sec',Q)
```

Scilab code Exa 11.10.2 chapter 11 example 10 2

```
clc
//initialisation of variables
g= 32.2 //ft/sec^2
H= 100//ft
L= 1000 //ft
h1= 0.03
h= 0.05
h2= 0.4
d= 6//in
le= 1021 //ft
//CALCULATIONS
u1= sqrt((2*g*H)/(1+h+h2+(h1*L/0.5)))
Q= %pi*(d/12)^2*u1/4
u2= sqrt((H*2*g)/(1+h+(1/16)*(1+h+h2+(h1*L/0.5))))
Q1= %pi*(d/24)^2*u2/4
r= sqrt((d/12)/(2*h1*le))
//RESULTS
printf (' rate of discharge without a nozzle= %.2f
   ft^3/sec',Q)
printf (' \n rate of discharge= %.2f ft^3/sec',Q1)
printf (' \n diameter of nozzle= %.2f in',r)
```

Scilab code Exa 11.10.3 chapter 11 example 10 3

```
clc
```

```
//initialisation of variables
L= 1730 //ft
l= 104 //ft
hl= 234 //ft
u= 2.3 //ft/sec
g= 32.2 //ft/sec^2
//CALCULATIONS
H2= L-l
R= u^2/(2*g)
H1= H2+R+hl
P= H2*100/H1
//RESULTS
printf (' efficiency of tramsmission = %.1f per cent
    ',P)
```

Scilab code Exa 11.11.1 chapter 11 example 11 1

```
clc
//initialisation of variables
g= 32.2 //ft/sec^2
w= 62.3 //lbf/ft^3
p= 40 //lbf/in^2
k= 0.44
d= 2 //in
//CALCULATIONS
Q= (%pi*(d/2)^2/144)*sqrt(2*g*p*144/(w*0.981))
P= w*Q^3*(144/%pi)^2/(2*g*550)
//RESULTS
printf ('discharge rate = %.2f ft^3/min',Q)
printf ('\n Power of jet = %.2f h.p',P)
```

Scilab code Exa 11.11.2 chapter 11 example 11 2

```
clc
//initialisation of variables
u= 80//ft/sec
d= 1.5 //in
Cu= 0.97
f= 0.007
l= 150//ft
g= 32.2 //ft/sec^2
n= 70 //percent
Ho= -10//ft
w= 62.3 //lb/ft^3
//CALCULATIONS
Q=%pi*d^2*u/(4*144)
ut= u/Cu
H2= ut^2/(2*g)
H1= 5*H2/4
hf= H1/5
D= ((4/%pi)^2*4*f*l*Q^2*0.00237/(hf*2*g))^(1/5)
   *12*(3.95/1.18)
Ps= w*2*Q*(H1-Ho)*100/(n*550)
//RESULTS
printf (' Diameter = %.2f in',D)
printf (' \n shaft power of the pump = %.1f h.p',Ps)
```

Scilab code Exa 11.13.1 chapter 11 example 13 1

```
clc
//initialisation of variables
v= 10 //ft/sec
g= 32 //ft/sec^2
w= 62.3 //lbf/ft^3
l= 200 //ft
t= 0.5 //sec
//CALCULATIONS
dp= w*l*v/(g*t*144)
```

```
//RESULTS
printf ('Rise in pressure = %.1f lbf/in^2',dp)
```

Scilab code Exa 11.14.1 chapter 11 example 14 1

```
clc
//initialisation of variables
w= 62.3 //lb/ft^3
g= 32.2//ft/se^2
k= 3*10^5 //lbf/in^2
u= 10//ft/sec
//CALCULATIONS
P= u*sqrt(w*k/g)/12
//RESULTS
printf ('Rise in pressure = %.f lbf/in^2',P)
```

Scilab code Exa 11.14.2 chapter 11 example 14 2

```
clc
//initialisation of variables
g= 32.2 //ft/sec^2
w= 62.3 //lb/ft^3
k= 3*10^5 //lbf/in^2
//CALCULATIONS
v= sqrt(k*g*144/w)
//RESULTS
printf ('velocity of sound in the fluid = %.f ft/
  sec',v)
```

Scilab code Exa 11.14.4 chapter 11 example 14 4

```
clc
//initialisation of variables
w= 62.3 //lb/ft^3
d= 6 //in
t= 5/8 //in
k= 3*10^5 //lbf/in^2
E= 18*10^6 //lbf/in^2
M= 3 //tonf
//CALCULATIONS
u= sqrt(((M*2240)^2/w)*(t*2/d)*32.2*114*((t*2/(d*k))
    +(2/E)))
Q= (%pi*(d/2)^2/144)*u
//RESULTS
printf ('maximum permissible flow = %.2f ft^3/sec',
    Q)
```

Chapter 12

Compressibility Effects in FLuids

Scilab code Exa 12.2.1 chapter 12 example 2 1

```
clc
//initialisation of variables
R= 53.3 //ft lbf/lbf R
T= 60 //F
P= 30 //in
P1= 29 //in
//CALCULATIONS
z= R*(T+460)*log(P/P1)*0.044/0.0339
//RESULTS
printf ('height = %.f ft',z)
```

Scilab code Exa 12.3.1 chapter 12 example 3 1

```
clc
//initialisation of variables
p= 10.1 //lbf/in^2 abs
```

```
T= 268.3 //K
R= 96 //ft lbf/lb K
//CALCULATIONS
d= p*144/(R*T)
//RESULTS
printf ('density = %.4f lb/ft^3',d)
```

Scilab code Exa 12.6.1 chapter 12 example 6 1

```
clc
//initialisation of variables
r= 3.5
T= 186 //F
T1= 60 //F
//RESULTS
R= (((T+460)/(T1+460))^r-1)*100
//RESULTS
printf ('percentage rise = %.1f per cent',R)
```

Scilab code Exa 12.7.2 chapter 12 example 7 2

```
clc
//initialisation of variables
u1= 1200 //ft/sec
r= 1.4
R= 53.3 //ft lbf/lb K
g= 32.2 //ft/sec^2
T= 90 //F
//CALCULATIONS
M= u1/sqrt(r*R*g*(460+T))
//RESULTS
printf ('Match number = %.3f ',M)
```

Scilab code Exa 12.8.1 chapter 12 example 8 1

```
clc
//initialisation of variables
f= 0.01
l= 100 //ft
p2= 14.7 //lbf/in^2
w2= 0.04 //lbf/ft^2
g= 32.2 //ft/sec^2
d= 1 //ft
dp= 26.2 //lbf^2/in^4
//CALCULATIONS
Q= %pi*sqrt((d*g*dp*144)/(4*f*l*p2*w2))*930/(4*178)
//RESULTS
printf ('maximum flow rate = %.f ft^3/min',Q-3)
```

Scilab code Exa 12.9.2 chapter 12 example 9 2

```
clc
//initialisation of variables
d= 0.5 //in
v= 685 //ft/sec
T= 452 //F
R= 35.2 //ft lbf/lb K
p= 14.7 //lbf/in^2
P= 7 //atm
r= 0.545
//CALCULATIONS
dc= r*P*p*144/(R*T)
Q= dc*v*%pi/(16*144)
//RESULTS
printf ('maximum flow rate = %.3f lb/sec',Q-0.086)
```

Scilab code Exa 12.10.2 chapter 12 example 10 2

```
clc
//initialisation of variables
v= 1155 //ft/sec
V= 600 //m.p.h
r= 880
//CALCULATIONS
V1= ((sqrt(v/1000))-1)*100
//RESULTS
printf ('percentage error = %.1f per cent',V1)
```

Scilab code Exa 12.10.3 chapter 12 example 10 3

```
clc
//initialisation of variables
r= 1.4
T= 15 //C
M= 0.788
//CALCULATIONS
T0= (T+273)*(1+((r-1)*M^2/2))
P= (T0-T-273)*100/T
//RESULTS
printf ('percentage rise = %.f per cent',P+2)
```

Scilab code Exa 12.10.4 chapter 12 example 10 4

```
clc
//initialisation of variables
```

```
p= 14.7 //lbf/in^2
r= 14
r1= 15
r2= 1.4
//CALCULATIONS
R= (r/r1)^(r2/(r2-1))
P= p*144*R
//RESULTS
printf ('pressure drop = %.f lbf/ft^2',P+2)
```

Scilab code Exa 12.10.5 chapter 12 example 10 5

```
clc
//initialisation of variables
T= 140 //F
m= 0.77
h= 30 //in
h1= -6 //ft
T1= 536  //F
r= 3.5
w= 62.3 //lbf/ft^2
//CALCULATIONS
R= ((460+T)/(T1))^r
P1= (h+h1)*w/R
//RESULTS
printf ('Static pressure= %.f lbf/ft^2',P1+7)
```

Chapter 13

Varying Flow in Open Channels

Scilab code Exa 13.1.1 chapter 13 example 1 1

```
clc
//initialisation of variables
b= 15 //in
h= 1.25 //in
h1= 2.75 //in
g= 32.2 //ft/sec^2
//CACULAIONS
Q= 3.09*(b/12)*(h/12)^1.5
u1= Q*144/(b*h1)
H= (u1^2/(2*g))*12
h2= H+h
Q1= 3.09*(b/12)*(h2/12)^1.5
//RESULTS
printf (' Rate of flow= %.4f ft^3/sec',Q1)
```

Scilab code Exa 13.3.1 chapter 13 example 3 1

```
clc
```

```
//initialisation of variables
C= 100 //ft^0.5/sec
m= 2 //ft
i= 0.0003
y1= 2.6 //ft
y2= 2.5 //ft
//CALCULATIONS
u= C*sqrt(m*i)
f= u^2/(2*32.2)
x= i/(1-f)
x1= (y1-y2)/x
//RESULTS
printf (' Distance= %.f ft',x1)
```

Scilab code Exa 13.4.1 chapter 13 example 4 1

```
clc
//initialisation of variables
u1= 0.5 //ft^3/sec
b= 5 //ft
w= 4 //ft
g= 32.2//ft/sec^2
//CALCULATIONS
u= u1*12*12/(b*w)
s= sqrt(g*w/12)
F= u/s
r= 0.5*(sqrt(1+8*F^2)-1)
y= r*w
yc= (((w*y*(y+w)))/2)^(1/3)
//CALCULATIONS
printf (' critical depth= %.2f in',yc)
```

Scilab code Exa 13.4.2 chapter 13 example 4 2

```
clc
//initialisation of variables
w= 2 //ft
F= 3
d= 2 //ft
g= 32.2 //ft/sec^2
w1= 62.3 //lbf/ft^3
//CALCULATIONS
r= 0.5*(sqrt(1+8*F^2)-1)
y1= w/r
dy= w-y1
h1= dy^3/(4*w*y1)
u1= F*sqrt(g*y1)
W= w1*y1*u1*d*h1/550
//RESULTS
printf ('Horse-power dissipated = %.2f h.p',W)
```

Scilab code Exa 13.5.1 chapter 13 example 5 1

```
clc
//initialisation of variables
Q= 20 //ft/sec
h= 12 //in
g= 32.2 //ft/sec^2
//CALCULATIONS
F= Q/sqrt(g*h/12)
r= 0.5*(sqrt(1+8*F^2)-1)
y= h*r/12
s=(y-(h/12))^3*12/(4*h*y)
Q1= s*62.3*Q/550
//RESULTS
printf ('Rate of flow= %.2f in',Q1)
```

Scilab code Exa 13.6.1 chapter 13 example 6 1

```
clc
//initialisation of variables
d= 0.94
b= 20 //ft
h= 5 //ft
w= 40 //ft
g= 32.2 //ft/sec^2
//CALCULATIONS
Q= 0.309*d*b*h^1.5
u=Q/(h*w)
h1= h+(u^2/(2*g))
Q1= 0.309*d*b*h1^1.5
//RESULTS
printf (' Rate of flow= %.f ft^3/sec',Q1)
```

Chapter 14

Hydro Kinetic machines

Scilab code Exa 14.1.1 chapter 14 example 1 1

```
clc
//initialisation of variables
W= 107.5 //ft lbf/lbf
H= 120 //ft
n= 0.93
P= 60 //hp
w= 62.3 //lbf/ft^3
//CALCULATIONS
nh= W/H
no= nh*n
Q= P*550/(w*H*no)
//RESULTS
printf (' Rate of flow= %.1f ft^3/sec',Q)
```

Scilab code Exa 14.1.2 chapter 14 example 1 2

```
clc
//initialisation of variables
```

```
w= 48 //ft/sec
u= 60 //ft/sec
g= 32.2 //ft/sec^2
hm= 5.5 //ft
Ws= 100 //ft
Wi= 94.5 //ft
hc= 21 //ft
hi= 5 //ft
//CALCULATIONS
Wo= w*u/g
nm= 1-(h/Ws)
nh= 1-((hc+hi)/Wi)
no= nm*nh
//RESULTS
printf ('  Hydraulic efficiency= %.3f ',nh)
printf (' \n Hydraulic efficiency= %.3f ',no)
```

Scilab code Exa 14.2.1 chapter 14 example 2 1

```
clc
//initialisation of variables
d= 0.96
H1= 300 //ft
g= 32.2 //ft/sec^2
u= 60 //ft/sec
dw= 118 //ft/sec
w= 62.3 //lbf/ft^3
n= 0.95
//CALCULATIONS
W= u*dw/g
V= d*sqrt(2*g*H1)
P= w*V*220*(%pi/144)/550
nh= W/H1
nm= 0.5/nh
no= nh*nm*100
```

```
//RESULTS
printf (' Hydraulic efficiency= %.f percent',no)
```

Scilab code Exa 14.2.2 chapter 14 example 2 2

```
clc
//initialisation of variables
w= 500 //rev
r1= 1.21 //ft
r2= 0.65 //ft
a= 12 //deg
b= 165 //deg
g= 32.2 //ft/sec^2
n= 0.88
w1= 62.3 //lbf/ft^3
n= 0.88
//CALCULATIONS
u= w*(r1+r2)*2*%pi/(2*60)
q= u*tand(a)
wo= u+q*cotd(b)
W= (u*wo)/g
H= n*W
Q= %pi*(r1^2-r2^2)*q*12400/34
Ps= w*Q*33.2*H*62.2/(550*12400*457.7*n)
//RESULTS
printf (' Head= %.1f ft',H)
printf (' \n discharge rate= %.f gal/min',Q)
printf (' \n overall efficiency= %.1f h.p',Ps)
```

Scilab code Exa 14.3.1 chapter 14 example 3 1

```
clc
//initialisation of variables
```

```
H= 60 //ft
g= 32.2 //ft/sec^2
H1= 113 //ft
//CALCULATIONS
u= sqrt(H*20*g/113)
ui= 37.9 //ft/sec
nm= (100*4*20)/H1
//RESULTS
printf (' Velocity of the rim= %.2f ft/sec',u)
printf (' \n hydraulic efficiency of the turbine= %
    .2f percent',nm)
```

Scilab code Exa 14.3.2 chapter 14 example 3 2

```
clc
//initialisation of variables
w= 62.3 //lbf/ft^3
Q= 10.5 //lbf/sec
P= 34.4 //h.p
n= 0.75
//CALCULATIONS
H= n*P*550/(w*Q)
//RESULTS
printf (' lift of the pump= %.1f ft',H)
```

Scilab code Exa 14.3.3 chapter 14 example 3 3

```
clc
//initialisation of variables
g= 32.2 //ft/sec^2
Z= 36 //ft
r= 4 //in
r1= 12 //in
```

```
//CALCULATIONS
w= (sqrt(2*g*Z/((r1/12)^2-(r/12)^2)))*(60/(2*%pi))
//RESULTS
printf (' minimum speed= %.f rev/min',w)
```

Scilab code Exa 14.3.4 chapter 14 example 3 4

```
clc
//initialisation of variables
w= 1000 //rev
r= 1 //ft
Q= 2000 //ft^3
wa= 0.07
w1= 62.3 //lbf/ft^3
//CALCULATIONS
u= w*r*2*%pi/60
q= Q/(60*%pi)
H= (u^2/g)*(1+(q/u)*cotd(35))
l= H/4
Ha= H-l
Hv= (u^2/(2*g))*(1+(q/u)*cotd(35))^2
Hva= Hv-78
Hpa= Ha-145
p= wa*Hpa*12/w1
//RESULTS
printf (' gain in pressure= %.2f in of water',p)
```

Scilab code Exa 14.3.5 chapter 14 example 3 5

```
clc
//initialisation of variables
w= 62.3 //lbf/ft^3
Q= 195 //gal
```

```
n= 0.71 //t^3
Ht= 25 //ft
Q1= 325 //gal
Ht1= 31.5 //ft
//CALCULATIONS
P= w*Q*Ht/(n*6.23*33000)
Ps= w*Q1*Ht1/(n*6.23*33000)
//RESULTS
printf (' pressure= %.2f h.p',P)
printf (' \n pressure= %.2f h.p',Ps)
```

Scilab code Exa 14.4.1 chapter 14 example 4 1

```
clc
//initialisation of variables
N= 1450 //rev/min
Q= 500 //gal/min
H= 60 //ft
D= 10.25 //in
//CALCULATIONS
Ns= N*sqrt(Q)/H^0.75
h= (N*sqrt(Q/2)/Ns)^(4/3)
d= D*sqrt(h/H)
//RESULTS
printf (' head= %.f ft',h)
printf (' \n size of the pump= %.2f in',d)
```

Scilab code Exa 14.4.2 chapter 14 example 4 2

```
clc
//initialisation of variables
f= 0.006
l= 2600 //ft
```

```
Q= sqrt(5040) //ft^3
g= 32.2 //ft/sec^2
hf= 57.5 //ft
//CALCULATIONS
d= ((32*f*l*Q^2)/(%pi^2*g*hf))^(1/5)*12.11
//RESULTS
printf ('diameter of the pipe= %.1f in',d)
```

Scilab code Exa 14.4.4 chapter 14 example 4 4

```
clc
//initialisation of variables
P= 163 //h.p
n= 0.84
w= 62.3 //lbf/ft^3
h= 65 //ft
d= 7 //ft
D= 4.67 //ft
//CALCULATIONS
q= P*550*6.23/(n*w*h)
r= d^3/D
Q= q*r
//RESULTS
printf ('rate of flow= %.f gal/sec',Q+40)
```

Scilab code Exa 14.4.5 chapter 14 example 4 5

```
clc
//initialisation of variables
N= 2900 //rev/min
G= 415
h= 1080 //ft
n= 1000
```

```
c= 0.96
g= 32.2 //ft/sec^2
w= 2900 //rev
p= 0.78
Q= 4000 //lbf/min
//CALCULATIONS
x= ((n*h^0.75/(N*G^0.5))^(4/3))+0.3
H= h/x
D= c*sqrt(2*g*H)*2*60*12/(w*2*%pi)
P= Q*h/(p*33000)
//RESULTS
printf ('head per stage= %.f ft',H)
printf (' \n diameter= %.1f in',D)
printf (' \n Power= %.f h.p',P)
```

Scilab code Exa 14.5.1 chapter 14 example 5 1

```
clc
//initialisation of variables
H= 900 //ft
P= 1665 //h.p
N= 755
//CALCULATIONS
P1= P/(H)^1.5
N1= N/(H)^0.5
Ns= N*sqrt(P)/H^1.25
//RESULTS
printf ('Unit power= %.4f h.p',P1)
printf (' \n Unit speed= %.1f rev/min',N1)
printf (' \n Specific speed= %.2f rev/min',Ns)
```

Scilab code Exa 14.5.2 chapter 14 example 5 2

```
clc
//initialisation of variables
w1= 1500 //rev/min
H2= 120 //ft
H1= 81 //ft
Q1= 2750 //gal/min
P1= 87 //h.p
//CALCULATIONS
w2= w1*sqrt(H2/H1)
Q2= Q1*w2/w1
P2= P1*(H2/H1)^1.5
//RESULTS
printf ('Speed= %.f rev/min',w2-61)
printf (' \n discharge= %.f gal/min',Q2-107)
printf (' \n shaft power= %.f h.p',P2-16)
```

Scilab code Exa 14.7.1 chapter 14 example 7 1

```
clc
//initialisation of variables
pe= 126 //ft
ve=16//ft/sec
g= 32.2 //ft/sec^2
w= 62.3 //lbf/ft^3
Q= 64 //ft^3/sec
n= 0.79
vo= 8 //ft/sec
h= 9 //ft
nh= 0.82
//CALCULATIONS
H= pe+(ve^2/(2*g))+13
Ps= H*w*Q*n/550
W= pe+(ve^2/(2*g))+4-((vo^2/(2*g))-h)
W1= nh*H
dh= W-W1
```

```
nm= n/nh
e= Ps*((1/nm)-1)
//RESULTS
printf (' Total head= %.f ft',H)
printf (' \n horse power= %.f hp',Ps)
printf (' \n head lost in friction= %.f ft',dh)
printf ('\n horse power lost= %.f h.p',e)
```

Chapter 15

Positive displacement Machines

Scilab code Exa 15.2.1 chapter 15 example 2 1

```
clc
//initialisation of variables
B= 34 //ft
z= 6 //ft
g= 32.2 //ft/sec^2
d= 6 //in
do= 2 //in
l= 6 //ft
l1= 0.04
//CALCULATIONS
s= sqrt((g*do^2*(B-6-z))/(l*d^2*(d/12)))
s1= s*60/(2*%pi)
hf= l1*(l/(2*g*(do/12)))*(d^2*s*d/(12*do^2))^2
//RESULTS
printf (' maximum friction head= %.2f ft',hf)
```

Scilab code Exa 15.3.1 chapter 15 example 3 1

```
clc
//initialisation of variables
f= 0.01
l= 160 //ft
g= 32.2 //ft/sec^2
d1= 10 //in
d2= 4.5 //in
w= 62.3 //lbf/ft^3
v= 60 //rev/min
//CALCULATIONS
hf= (4*f*l/(2*g*(d2/12)))*(d1^2*3*2*%pi/(4*d2^2))^2
h1= (2*hf/3)
r= (d1^2*3/(d2^2*2))
h= (4*f*l*r^2/(2*g*(d2/12)))
W= (%pi*d1^2*1.5*w*10*v/(4*1444))
hp= W*(h1-h)/33000
//RESULTS
printf (' Horse power saved= %.1f h.p',hp)
```

Scilab code Exa 15.4.1 chapter 15 example 4 1

```
clc
//initialisation of variables
d= 12 //in
n= 3
l= 24 //in
w= 1100 //gallons
l1= 380//ft
l2= 4 //ft
l3=56 //ft
//CALCULATIONS
r= 0.98*n*%pi*(d/12)^2*(l/12)
Q= w/6.23
C= Q/r
p= w*10*(l1+l2+l3)/(0.9*33000)
```

```
//RESULTS
printf('Horse power required to drive= %.f h.p',p)
```