Scilab Textbook Companion for Fluid Mechanics by A. K. Choudhary and Om Prakash[1]

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Book Description

Title: Fluid Mechanics

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

Contents

List of Scilab Codes

Chapter 2

Properties of Fluids

Scilab code Exa 2.1 Sp Weight Mass density Sp Gravity

```
//Example 2.1
clc;
clear;
close;

//Given data :
V=10;//in m^3
W=80;//in kN
g=9.81;//gravity accelerat
w_water=9.81;//specific weight of water
format('v',6);
w=W/V;//specific weight in kN/m^3
disp(w,"Specific weight of liquid in kN/m^3 : ");
mass_density=w*1000/g;//kg/m^3
disp(mass_density,"Mass density of liquid in kg/m^3 : ");
specific_gravity=w/w_water;//unitless
disp(specific_gravity,"Specific gravity : ");
```

Scilab code Exa 2.2 Bulk modulus of elesticity

```
//Example 2.2
clc;
clear;
close;

//Given data :
p1=750;//N/cm^2
p2=1400;//N/cm^2
dvBYV=-0.150;//in %
format('v',9);
dp=p2-p1;//in N/cm^2
dp=dp*10^4;//in N/m^2
K=-dp/(dvBYV/100);//N/m^2
disp(K,"Bulk modulus(N/m^2) : ");
```

Scilab code Exa 2.3 Increase of pressure

```
//Example 2.3
clc;
clear;
close;

//Given data :
Kwater=2.10*10^6;//kN/m^2
Kair=140;//kN/m^2
dvBYV=-1;//in %
format('v',9);
//For Water :
dp=-Kwater*dvBYV/100;//kN/m^2
disp(dp,"Increase of pressure in water in kN/m^2");
//For Air :
dp=-Kair*dvBYV/100;//kN/m^2
disp(dp,"Increase of pressure in air in kN/m^2");
```

Scilab code Exa 2.4 Force and power required

```
//Example 2.4
clc;
clear;
close;

//Given data :
A=0.2;//m^2
dy=0.02/100;//m
du=20/100;//cm/s
mu=0.001;//Ns/m^2
tau=mu*du/dy;//in N/m^2
F=tau*A;//N
disp(F,"Force required in N : ");
Power=F*du;//Watts
disp(Power,"Power required in W : ");
```

Scilab code Exa 2.5 Kinematic Viscosity

```
//Example 2.5
clc;
clear;
close;
//Given data :
format('e',10);
mu=0.1;//Ns/m^2
Sp_gravity_liquid=2.1;
mass_density_water=1000;//in kg/m^3
rho=Sp_gravity_liquid*mass_density_water;//kg/m^3
v=mu/rho;//m^2/sec
```

```
disp(v,"Kinematic viscosity of liquid in m^2/sec : ");
```

Scilab code Exa 2.6 Calculate capillary rise

```
//Example 2.6
clc;
clear;
close;
//Given data :
format('v',6);
d=2;//in mm
d=d/1000;//in m
sigma_water=0.073;//N/m
sigma_mercury=0.510;//N/m
//Water-glass contact
w1=9.81;//kN/m^3(specific weight of water)
w1=w1*10^3;//N/m^3
theta=0;//in degree
h=4*sigma_water*cosd(theta)/w1/d;//in mm
disp(h*1000,"capillary rise for water glass contact in mm : ");
//Mercury-glass contact
w2=13.6*9.81;//kN/m^3(specific weight of mercury)
w2=w2*10^3;//N/m^3
theta=130;//in degree
h=4*sigma_mercury*cosd(theta)/w2/d;//in mm
disp(h*1000,"capillary rise for mercury glass contact in mm: ");
```

Scilab code Exa 2.7 Intensity of Pressure

```
//Example 2.7
```

```
clc;
clear;
close;

//Given data :
format('v',5);
d=6;//in mm
d=d/1000;//in m
sigma=0.0755;//N/m
//At equillibrium : p*%pi*r^2=sigma*2*%pi*r
r=d/2;//in m
p=2*sigma/r;//N/m^2
disp(p,"Intensity of pressure in N/m^2 or Pascals :
   ");
```

Chapter 3

Hydro Static Pressure

Scilab code Exa 3.1 Intensity of pressure

```
//Example 3.1
clc;
clear;
close;
format('v',7);
//Given data :
D=30*10^-2;//in m
F=9810;//in N
A=%pi*D^2/4;//in m^2
p=F/A;//in N/m^2 or Pa
p=p/1000;//kPa
disp(p,"Intensity of pressure at the bottom of
    container in kPa : ");
```

Scilab code Exa 3.2 Intensity of pressure

```
//Example 3.2
clc;
```

```
clear;
close;
format('v',7);
//Given data :
h=1.5;//in m
w_w=9.81;//in kN/m^3
w_g=1.26;//in kN/m^3
w_m=13.6;//in kN/m^3
f=h*w_w;//kN/m^2
disp(f,"Intensity of pressure exerted by water
    column in kN/m^2 : ");
f=h*w_w*w_g;//kN/m^2
disp(f,"Intensity of pressure exerted by glycerine
    column in kN/m^2 : ");
f=h*w_w*w_m;//kN/m^2
disp(f,"Intensity of pressure exerted by mercury
    column in kN/m^2 : ");
```

Scilab code Exa 3.3 Depth of alcohol

```
//Example 3.3
clc;
clear;
close;
format('v',6);
//Given data :
p=2;//in kN/m^2
w_w=9.81;//in kN/m^3
w_alcohol=w_w*0.789;//in kN/m^3
w_m=13.6;//in kN/m^3
H=p/w_alcohol;//in m
disp(H,"Depth of alcohol in meter : ");
P_head_w=p/w_w;//m
disp(P_head_w,"Pressure head in terms of water in
    meter : ");
```

```
P_head_m=p/w_w/w_m;//m
disp(P_head_m,"Pressure head in terms of mercury in
    meter : ");
```

Scilab code Exa 3.4 Convert pressure head

```
//Example 3.4
clc;
clear;
close;
format('v',7);
//Given data :
Hwater=6;//m(Pressure head of water)
S_oil=0.70;//(specific gravity of oil)
H_oil=Hwater/S_oil;//in m(Pressure head in terms of
    oil)
disp(H_oil,"Pressure head of water in terms of oil
    in meter : ");
S_oil=0.825;//(specific gravity of oil)
S_mercury=13.6;//(specific gravity of mercury)
Hmercury=70/100;//m(Pressure head of mercury)
H_oil=S_mercury/S_oil*Hmercury;//in m(Pressure head
    in terms of oil)
disp(H_oil,"Pressure head of mercury in terms of oil
     in meter : ");
```

Scilab code Exa 3.5 Calculate total pressure

```
//Example 3.5
clc;
clear;
close;
format('v',7);
```

```
//Given data :
w=9.81;//in kN/m^3
l=3;//in m
b=2;//in m
h=1;//in m
f_bottom=w*h;//in kN/m^2(Pressure intensity at
    bottom)
p_bottom=f_bottom*l*b;//kN
disp(p_bottom,"Total pressure on the bottom in kN :
    ");
f_long_vertical=f_bottom/2;//kN
p_long_vertical=f_long_vertical*l*h;//kN
disp(p_long_vertical,"Total pressure on long
    vertical wall in kN : ");
f_short_vertical=f_bottom/2;//kN
p_short_vertical=f_short_vertical*b*h;//kN
disp(p_short_vertical,"Total pressure on short
    vertical wall in kN : ");
```

Scilab code Exa 3.6 Calculate force on vertical wall

```
//Example 3.6
clc;
clear;
close;
format('v',7);
//Given data :
p_water=1000;//in kg/m^3
p_liquid=800;//in kg/m^3
g=9.81;//gravity constant
h1=1.5;//m
px1=p_liquid*g*h1/1000;//kN/m^2
disp(px1,"Pressure at a point 1.5 meter below free
    surface in kN/m^2 : ");
h2=2;//m
```

```
px2=p_liquid*g*h2/1000;//kN/m^2
disp(px2,"Pressure at a point 2 meter below free surface in kN/m^2 : ");
h31=2;//m(for liquid)
h32=0.5;//m(for water)
px1=p_liquid*g*h31/1000;//kN/m^2
px2=p_water*g*h32/1000;//kN/m^2
px3=(px1+px2);//kN/m^2
disp(px3,"Pressure at a point 2.5 meter below free surface in kN/m^2 : ");
h=2;//meter(water level)
b=8;//meter(width of wall)
p_bottom=px1+(p_water*g*h)/1000;//kN/m^2
p_avg1=(px1+0)/2;//kN/m^2(top 2m liquid layer)
p_avg2=(px1+p_bottom)/2;//kN/m^2(top 2m water layer)
F_per_meter=p_avg1*h*1+p_avg2*h*1;//kN
Fwall=F_per_meter*b;//kN
disp(Fwall,"Force on the wall in kN : ");
```

Scilab code Exa 3.7 Find force and depth

```
//Example 3.7
clc;
clear;
close;
format('v',7);
//Given data :
b=3;//in meter
h=3;//in meter
S_oil=0.8;//(specific gravity of oil)
A=1/2*h*b;//in m^2
x_bar=2/3*3;//in meter
SW_water=9.81*1000;//in N/m^3
SW_oil=SW_water*S_oil;//in N/m^3
F_surface=SW_oil*A*x_bar;//in kN
```

```
IG=b*h^3/36;//in m^3
h_bar=IG/A/x_bar+x_bar;//in meter
disp(h_bar,"Force shall act at depth of centre of pressure. This depth in meter is : ");
```

Scilab code Exa 3.8 Total pressure and centre of pressure

```
//Example 3.8
clc;
clear;
close;
format('v',6);
//Given data :
l=3;//in meter
b=2;//in meter
p=2*10^6;//in Pa
g=9.81;//gravity constant
w=g*1000;//in N/m^3
h=p/w;//in meter
xbar=h-1.5;//in meter
A=l*b;//in m^2
p_gate=w*A*xbar/10^6;//in MN
disp(p_gate,"Total pressure on the gate in MN : ");
IG=b*l^3/12;//in m^3
h_bar=IG/A/xbar+xbar;//in meter
disp("Position of centre of pressure is "+string(h_bar-xbar)+" meter below the centroid of gate.");
```

Scilab code Exa 3.9 Total pressure and centre of pressure

```
//Example 3.9
clc;
```

```
clear;
close;
format('v',9);
//Given data :
g=9.81;//gravity
GH=4;//meter
IJ=4;//meter
IC=2;//meter
GC=3;//meter
AG=(10-4)/2;//meter
BH=(10-4)/2;//meter
EI=AG*IC/GC;//meter
JF=AG*IC/GC;//meter
EF=EI+IJ+JF;//meter
A=(8+4)/2*2;//in m^2
a=4;//meter
b=8;//meter
d=2;//meter
xbar=(2*a+b)/(a+b)*d/3;//in meter
w=g*1000;//in N/m^3
p_gate=w*A*xbar/10^3;//in kN
disp(p_gate,"Total pressure in kN : ");
IG=(a^2+4*a*b+b^2)/(a+b)*d^3/36;//in m^3
h_bar=IG/A/xbar+xbar;//in meter
disp("Depth of centre of pressure is "+string(h_bar)
   +" meter.");
```

Scilab code Exa 3.10 Total pressure and centre of pressure

```
//Example 3.10
clc;
clear;
close;
format('v',9);
//Given data :
```

```
g=9.81;//gravity
xbar=8;//meter
D=4;//meter
A=%pi*D^2/4;//meter^2
w=g*1000;//in N/m^3
p=w*A*xbar/10^3;//in kN
disp(p,"Total pressure in kN : ");
IG=%pi*D^4/64;//in m^4
h_bar=IG/A/xbar+xbar;//in meter
disp("Depth of centre of pressure is "+string(h_bar)
   +" meter.");
//Answer of total pressure is wrong in the book.
```

Scilab code Exa 3.11 Total pressure and centre of pressure

```
//Example 3.11
clc;
clear;
close;
format('v',6);
//Given data :
g=9.81;//gravity
D=4;//meter
xbar=(10+7)/2;//meter
A=%pi*D^2/4;//meter^2
w=g*1000;//in N/m^3
p=w*A*xbar/10^6;//in MN
disp(p,"Total pressure in MN : ");
BC=3;//meter
AB=4;//mete
sin_theta=BC/AB;
IG=%pi*D^4/64;//in m^4
h_bar=IG/A/xbar*sin_theta^2+xbar;//in meter
disp("Position of centre of pressure is "+string(
   h_bar)+" meter.");
```

Scilab code Exa 3.12 Determine total pressure

```
//Example 3.12
clc;
clear;
close;
format('v',6);
//Given data :
a=3;//meter
b=4;//meter(altitude)
S=1.2;//specific gravity
theta=30;//degree
d=2.5;//meter
g=9.81;//gravity
AG=b/3;//meter
xbar=d+AG*sind(theta);//meter
A=1/2*a*b;//meter^2
w=S*g*1000;//in N/m^3
p=w*A*xbar/10^3;//in kN
disp(p,"Total pressure in kN : ");
IG=a*b^3/36;//in m^4
h_bar=IG/A/xbar*(sind(theta))^2+xbar;//in meter
disp("Depth of centre of pressure is "+string(h_bar)
    +" meter.");
```

Scilab code Exa 3.13 Total pressure and centre of pressure

```
//Example 3.13
clc;
clear;
close;
```

```
format('v',6);
//Given data :
a=8;//meter
b=6;//meter
h=3;//meter
CD=2;//meter
theta=30;//degree
A=(a+b)/2*h;//meter^2
AB=(a+2*b)/(a+b)*h/3;//meter
x1bar=AB;//meter
BC=AB*sind(theta);//meter
BD=BC+CD;//meter
xbar=BD;//meter
g=9.81;//gravity
w=g*1000;//in N/m^3
p=w*A*xbar/10^3;//in kN
disp(p,"Total pressure in kN : ");
IG=(a^2+b^2+4*a*b)/(a+b)*h^3/36;//in m^4
h_bar=IG/A/xbar*(sind(theta))^2+xbar;//in meter
disp("Depth of centre of pressure is "+string(h_bar)
    +" meter.");
```

Scilab code Exa 3.14 Force and reaction at hinge

```
//Example 3.14
clc;
clear;
close;
format('v',7);
//Given data :
l=2;//meter
b=2;//meter
p_i=98.1;//kN/m^3(Pressure intensity)
w=9.81;//kN/m^2
BC=1;//meter
```

```
AB=2;//meter
theta=30;//degree
B=p_i/w;//m
BD=BC*sind(theta);//m
xbar=10+0.5;//meter
A=l*b;//m^2
p=w*A*xbar;//kN
IG=(2*l^3)/12;//in m^4
h_bar=IG/A/xbar*(sind(theta))^2+xbar;//in meter
DI=h_bar-xbar;//m
FC=DI/sind(theta);//m
FB=FC+BC;//meter
P=p*FB/AB;//kN
disp(P,"Force in kN : ");
RB=p-P;//kN
disp(RB,"Reaction at hinge B in kN : ");
//Answer in the book is slightly differ due to
    limited accuracy used in the book as compared to
    SCILAB.
```

Scilab code Exa 3.15 Horizontal force

```
//Example 3.15
clc;
clear;
close;
format('v',7);
//Given data :
l=4;//meter
b=2;//meter
h=1.8;//meter
w=9.81;//kN/m^2
xbar=6-2//meter
A=l*b;//m^2
P=w*A*xbar;//kN
```

```
IG=(2*l^3)/12;//in m^4
h_bar=IG/A/xbar+xbar;//in meter
// As P acts at h_bar-xbar :
F=P*((h_bar-xbar)-(b-h))/h;//kN
disp(F,"Horizontal Force in kN : ");
```

Scilab code Exa 3.16 Total pressure and centre of pfressure

```
//Example 3.16
clc;
clear;
close;
format('v',7);
//Given data :
b=2;//meter
d=3;//meter
h=2;//meter
w=9.81;//kN/m^2
xbar=2+3/2;//meter
A=b*d;//m^2
P=w*A*xbar;//kN
disp(P,"Total Pressure in kN : ");
IG=(b*d^3)/12;//in m^4
h_bar=IG/A/xbar+xbar;//in meter
disp(h_bar,"Position of centre of pressure in meter
    : ");
```

Scilab code Exa 3.17 Total pressure and centre of pressure

```
//Example 3.17
clc;
clear;
close;
```

```
format('v',7);
//Given data :
b=4;//meter
d=4;//meter
h=8;//meter
w=9.81;//kN/m^2
xbar=8;//meter
A=b*d;//m^2
P=w*A*xbar;//kN
disp(P,"Total Pressure in kN : ");
IG=(b*d^3)/12;//in m^4
h_bar=IG/A/xbar+xbar;//in meter
disp(h_bar,"Position of centre of pressure in meter
    : ");
```

Scilab code Exa 3.18 Total Pressure and centre of pressure

```
//Example 3.18
clc;
clear;
close;
format('v',7);
//Given data :
D=1.5;//meter
BE=2;//meter
AD=0.75;//meter
CE=AD;//meter
BC=BE-AD;//meter
FG=CE+BC/2;//meter
xbar=FG;//meter
w=9.81;//kN/m^2
A=%pi*D^2/4;//m^2
AB=D;//meter
sin_theta=BC/AB;
P=w*A*xbar;//kN
```

```
disp(P,"Total Pressure in kN : ");
IG=(%pi/64*D^4);//in m^4
h_bar=IG/A/xbar*sin_theta^2+xbar;//in meter
disp(h_bar,"Position of centre of pressure in meter
    : ");
```

Scilab code Exa 3.19 Total pressure and centre of pressure

```
//Example 3.19
clc;
clear;
close;
format('v',7);
//Given data :
b=3;//meter
a=3;//meter
S_oil=0.8;//specific gravity of oil
w=9.81*S_oil;//kN/m^2
xbar=1/3*b;//meter
A=1/2*a*b;//m^2
P=w*A*xbar;//kN
disp(P,"Total Pressure in kN : ");
IG=(a*b^3)/36;//in m^4
h_bar=IG/A/xbar+xbar;//in meter
disp(h_bar,"Centre of pressure in meter : ");
```

Scilab code Exa 3.20 Total hydro static pressure and centre of pressure

```
//Example 3.20
clc;
clear;
close;
format('v',7);
```

```
//Given data :
a=2;//meter
b=1;//meter
d=2;//meter
w=9.81;//kN/m^2
xbar=2+a/2;//meter
A=a*b;//m^2
P=w*A*xbar;//kN
disp(P,"Total Pressure in kN : ");
IG=(b*d^3)/12;//in m^4
h_bar=IG/A/xbar+xbar;//in meter
disp(h_bar,"Position of centre of pressure in meter : ");
```

Scilab code Exa 3.21 Resultant pressure and direction

```
//Example 3.21
clc;
clear;
close;
format('v',7);
//Given data :
r=2;//meter
l=4;//meter
A=r*l;//m^2
xbar=2+r/2;//meter
w=9.81;//kN/m^2
PH=w*A*xbar;//kN
disp(PH,"Horizontal component of resulting Pressure in kN : ");
PV=2*r*l*w+%pi*r^2/4*l*w;//kN
disp(PV,"Verticalal component of resulting Pressure in kN : ");
IG=(l*r^3)/12;//in m^4
h_bar=IG/A/xbar+xbar;//in meter
```

```
disp(h_bar,"Position of centre of horizontal
    component of pressure in meter : ");
x=(2*r+%pi*r^2/4*(4*r/3/%pi))/(2*r+%pi*r^2/4);//
    meter
P=sqrt(PH^2+PV^2);//kN
disp(P,"Resultant pressure in kN : ");
theta=atand(PV/PH);//degree
disp(theta,"Direction of resultant pressure in
    degree : ");
```

Scilab code Exa 3.22 Resultant pressure and angle of pressure

```
//Example 3.22
clc;
clear;
close;
format('v',7);
//Given data :
A=2*1;//m^2
xbar=2+2/2;//meter
w=9.81;//kN/m^2
PH=w*A*xbar;//kN
disp(PH,"Horizontal component of resultant Pressure
    in kN : ");
PV=w*[2*2+2*2-%pi*2^2/4]*1;//kN
disp(PV,"Verticalal component of resultant Pressure
    in kN : ");
P=sqrt(PH^2+PV^2);//kN
disp(P,"Resultant pressure in kN : ");
theta=atand(PV/PH);//degree
disp(theta,"Direction of resultant pressure in
    degree : ");
```

Scilab code Exa 3.23 Gorizontal and vertical components of pressure

```
//Example 3.23
clc;
clear;
close;
format('v',7);
//Given data :
ABbar=sqrt(2)*4;//meter
xbar=ABbar/2;//meter
A=ABbar*1;//m^2
w=9.81;//kN/m^2
PH=w*A*xbar;//kN
disp(PH,"Horizontal component of resultant Pressure
    in kN : ");
hbar=2/3*ABbar;//meter
disp("Position of horizontal component of pressure
    is "+string(hbar)+" meter below free water
    surface.");
PV=w*[%pi*4^2/4-4*4/2]*1;//kN
disp(PV,"Verticalal component of resultant Pressure
    in kN : ");
```

Scilab code Exa 3.24 Maximum and minimum stress

```
//Example 3.24
clc;
clear;
close;
format('v',9);
//Given data :
h=24;//meter
b=15;//meter
g=9.81;//gravity constant
Wm=2000*g;//N/m^3
```

```
W=b*h/2*Wm;//N
w=9.81;//kN/m^2
PH=w*20^2/2*1000;//N
y=PH/W*20/3+5;//meter
e=y-b/2;//meter
MaxStress=W/b*(1+6*e/b);//N/m^2
disp(MaxStress,"Maximum stress in N/m^2 : ");
MinStress=W/b*(1-6*e/b);//N/m^2
disp(MinStress,"Minimum stress in N/m^2 : ");
//Answer in the book is slightly differ due to
    limited accuracy used in the book as compared to
    SCILAB.
```

Chapter 4

Measurement of Pressure

Scilab code Exa 4.1 Gauge units and absolute units

```
//Example 4.1
clc;
clear;
close;
format('v',9);
//Given data :
p=5;//kg/cm^2
disp("Gauge units : ");
disp(p/10^-4,"Pressure Intensity in kg/m^2 : ");
g=9.81;//gravity constant
disp(p*g/10^-4,"Pressure Intensity in N/m^2 : ");
disp(p*g/10^-4,"Pressure Intensity in Pa : ");
disp(p*g/10^3/10^-4,"Pressure Intensity in kPa : ");
disp(p*g/10^6/10^-4,"Pressure Intensity in MPa : ");
disp("In terms of head : ");
w=1000;//kg/m^3 for water
h=p*10^4/w;//meter of water
disp("Pressure is  : "+string(h)+" meter of water.")
    ;
w=13.6*1000;//kg/m^3 for mercury
h=p*10^4/w;//meter of mercury
```

```
disp("Pressure is   : "+string(h)+" meter of mercury.
   ");
disp("Absolute units : ");
Patm=760;//mm of mercury
Patm=760*13.6/1000;//m of water
Patm=Patm*1000;//kg/m^2
Pabs=p+Patm;//kg/m^2
disp(Pabs,"Absolute pressure in kg/m^2 : ");
disp(Pabs*10^4,"Absolute pressure in kg/cm^2 : ");
disp(Pabs*10^4*g,"Absolute pressure in N/m^2 : ");
disp(Pabs*10^4*g,"Absolute pressure in Pa : ");
disp(Pabs*10^5/10^3,"Absolute pressure in kPa : ");
disp(Pabs*10^5/10^6,"Absolute pressure in MPa : ");
h1=p*10^4/w;//meter of water
h2=p*10^4/1000;//meter of water
h=h1+h2;////meter of water
disp(h,"Absolute pressure head in terms of water in
   meter : ");
w=13.6*1000;//kg/m^3 for mercury
h=p*10^4/w+760/1000;//meter of mercury
disp(h,"Absolute pressure head in terms of mercury
   in meter : ");
```

Scilab code Exa 4.2 Pressure intensity and tube reading

```
//Example 4.2
clc;
clear;
close;
format('v',9);
//Given data :
w=1000;//kg/m^3
h=50/1000;//m
p=w*h;//kg/m^2
p=p*9.81;//N/m^2 or Pa
```

```
disp(p,"Pressure Intensity in Pa : ");
alfa=30;//degree
h=50;//mm
l=h/sind(alfa);//mm
disp(l,"Reading in tube in mm : ");
```

Scilab code Exa 4.3 Convert pressure head

```
//Example 4.3
clc;
clear;
close;
format('v',7);
//Given data :
S1=13.6;//sp. gravity of mercury
S2=1;//sp. gravity of water
H1=5;//m
H2=S1*H1/S2;//m
disp("(i) Pressure is "+string(H2)+" meter of water.
   ");
S2=0.79;//sp. gravity of kerpsene
H1=5;//m
H2=S1*H1/S2;//m
disp("(ii) Pressure is "+string(H2)+" meter of
   kerosene.");
S2=1.7;//sp. gravity of fluid
H1=5;//m
H2=S1*H1/S2;//m
disp("(iii) Pressure is "+string(H2)+" meter of
   fluid.");
```

Scilab code Exa 4.4 Pressure in the tribe

```
//Example 4.4
clc;
clear;
close;
format('v',7);
//Given data :
S=0.9;//sp. gravity of liquid
Sm=13.6;//sp. gravity of mercury
S1=Sm/S;//sp. gravity
w=S*9.81;//kN/m^3
h2=500/1000;//m
h1=300/1000;//m
a_BY_A=1/80;//ratio of area
pa=w*(h2*[(S1-1)*a_BY_A+S1]-h1);//kPa
disp(pa,"Pressure in the pipe in kPa: ");
```

Scilab code Exa 4.5 Pressure intensity of liquid

```
//Example 4.5
clc;
clear;
close;
format('v',8);
//Given data :
S1=1.2;//sp. gravity
S2=13.6;//sp. gravity
w=1000;//kg/m^3
h2=50/1000;//m
h1=200/1000;//m
pa=w*(S2*h1-S1*h2);//kg/m^2
disp(pa,"Pressure in the pipe in kg/m^2: ");
disp(pa*9.81,"Pressure in the pipe in Pa: ");
```

Scilab code Exa 4.6 calculate Pressure intensity

```
//Example 4.6
clc;
clear;
close;
format('v',8);
//Given data :
S=1;//sp. gravity
w=1000;//kg/m^3
h2=50/1000;//m
h1=200/1000;//m
pa=w*S*(h1-h2);//kg/m^2
disp(pa,"Pressure in the pipe in kg/m^2: ");
disp(pa*9.81,"Pressure in the pipe in Pa: ");
```

Scilab code Exa 4.7 Calculate pressure intensity

```
//Example 4.7
clc;
clear;
close;
format('v',9);
//Given data :
S1=0.005;//sp. gravity
S2=1;//sp. gravity
Patm=1.014*10^5;//Pa
h=50/1000;//m
w=1000;//kg/m^3
pa=-w*S2*h;//kg/m^2
Pabs=pa*9.81+Patm;//
disp(abs(pa*9.81),"Pressure intensity of gas in Pa(
    Vaccum): ");
disp(Pabs,"Absolute pressure in the pipe in Pa: ");
```

Scilab code Exa 4.8 Difference of pressure head

```
//Example 4.8
clc;
clear;
close;
format('v',9);
//Given data :
S1=0.9;//sp. gravity
S2=13.6;//sp. gravity
h1=12.5/100;//m
P_AB=h1*(S2-S1);//meter of water
disp("Difference in pressure head at the points A &
   B is "+string(P_AB)+" meter of water");
w=1000;//kg/m^3
P_diff=P_AB*w*9.81;//Pa or Nm^2
disp(P_diff,"In terms A pressure entirely, the
   difference of pressure in N/m^2 : ");
```

Scilab code Exa 4.9 Difference of Pressure

```
//Example 4.9
clc;
clear;
close;
format('v',9);
//Given data :
S1=1;//sp. gravity
S2=13.6;//sp. gravity
h1=120/1000;//m
P_diff=h1*(S2-S1);//meter of water
```

```
disp(" Difference in pressure head is "+string(P_diff
    )+" meter of water");
w=1000; //kg/m^3
P_diff=P_diff*w*9.81; //Pa or Nm^2
disp(P_diff," In terms of pressure intensity , the
    difference of pressure in N/m^2 : ");
```

Scilab code Exa 4.10 Pressure difference between two vessels

```
//Example 4.10
clc;
clear;
close;
format('v',9);
//Given data :
S1=0.81; //sp. gravity
S2=1.2; //sp. gravity
S3=13.6; //sp. gravity
h3=200/1000; //m
h2=50/1000; //m
h1=100/1000; //m
w=1000; //kg/m^3
pAB=((h1*(S2-S1)+h2*(S3-S1)-h3*S1))*w; //Kg/m^2
disp(pAB,"Pressure difference between the two vessel
     in kg/m^2: ");
```

Scilab code Exa 4.11 Difference of pressure between two vessels

```
//Example 4.11
clc;
clear;
close;
format('v',9);
```

```
//Given data :
S1=1.9;//sp. gravity
S2=1.2;//sp. gravity
S3=0.79;//sp. gravity
h2=545/1000;//m
h1=750/1000;//m
h3=h1-h2;//m
w=1000*9.81;//N/m^3
pAB=(h1*S1-h2*S2-h3*S3)*w;//N/m^2
disp(pAB,"Pressure difference between the two vessel
    in N/m^2: ");
```

Scilab code Exa 4.12 Pressure difference between vessels

```
//Example 4.12
clc;
clear;
close;
format('v',9);
//Given data :
S1=0.005;//sp. gravity
S2=0.79;//sp. gravity
S3=13.6;//sp. gravity
h=30/1000;//m
w=1000*9.81;//N/m^3
pAB=h*(S3-S2)*w;//N/m^2
disp(pAB,"Pressure difference between the two vessel
    in N/m^2: ");
```

Scilab code Exa 4.13 Reading of manometer

```
//Example 4.13
clc;
```

```
clear;
close;
format('v',4);
//Given data :
S1=1.25;//sp. gravity
S2=1.05;//sp. gravity
S3=0.79;//sp. gravity
h=30/1000;//m
w=1000;//kg/m^3
//pA=pB
h=(0.15*w*S2-S1*w*0.15)/(S3*w-w*S2);//m
h=h*1000;//mm
disp(h,"Reading of manometer in mm : ");
```

Scilab code Exa 4.14 Difference of pressure

```
//Example 4.14
clc;
clear;
close;
format('v',9);
//Given data :
S1=1;//sp. gravity of water
S2=1;//sp. gravity of water
S3=0.9;//sp. gravity of oil
h3=100/1000;//meter
w=9.81*1000;//N/m^3
pAB=w*(h3-h3*S3);//N/m^2
disp(pAB,"Difference of pressure in N/m^2 or Pa : ")
    ;
```

Chapter 5

Fundamentals of Flow

Scilab code Exa 5.1 Find Power required

```
//Example 5.1
clc;
clear;
close;
format('v',9);
//Given data :
m=2000;//litre or kg(1 litre water =1kg)
M=m/60;//kg/s
p=4.5;//bar
p=p*10^5;//N/m^2
g=9.81;//constant
w=g*1000;//N/m^3
H=p/w;//m
Power=M*g*H/1000;//kW
disp(Power,"Power required in kW : ");
```

Scilab code Exa 5.2 Discharge and velocity of flow

```
//Example 5.2
clc;
clear;
close;
format('v',9);
//Given data :
v1=400*10^-3;//m/s
d1=300/1000;//meter
d2=450/1000;//meter
A1=%pi*d1^2/4;//m^2
A2=%pi*d2^2/4;//m^2
Q1=A1*v1*1000;//litres/sec(1m^3=1000litres)
disp(Q1,"Discharge of pipe in litres/sec : ");
v2=(Q1/1000)/A2;//m/s(Q1=Q2)
disp(v2,"Mean velocity of flow in m/s : ");
//Answer of discharge is wrong in the book.
```

Scilab code Exa 5.3 Datum Velocity Head Pressure head

```
//Example 5.3
clc;
clear;
close;
format('v',7);
//Given data :
PotentialHead=2;//meter of fluid
disp("Potential Head is "+string(PotentialHead)+"
    meter of fluid.");
v=5;//m/s
g=9.81;//constant
VelocityHead=v^2/2/g;//m
disp("Velocity Head is "+string(VelocityHead)+"
    meter of fluid.");
w=g*1000;//N/m^3
S=0.8;//sp. gravity of fluid
```

```
p=200; //kPa
PressureHead=p*10^3/w/S; //meter of fluid
disp("Pressure Head is "+string(PressureHead)+" meter of fluid.");
TotalHead=PotentialHead+VelocityHead+PressureHead; //meter of fluid
disp("Total Head is "+string(TotalHead)+" meter of fluid.");
```

Scilab code Exa 5.4 Calculate total energy

```
//Example 5.4
clc;
clear;
close;
format('v',8);
//Given data :
p=0.8/10^-4; //kg/m^2
datumH=4; //meter
v=0.8; //m/s
g=9.81; //constant
VelocityH=v^2/2/g; //m
w=1000; //kg/m^3
PressureH=p/w; //meter of fluid
TotalH=datumH+VelocityH+PressureH; //meter of fluid
disp("Total Energy is "+string(TotalH)+" meter.");
```

Scilab code Exa 5.5 Direction of flow

```
//Example 5.5
clc;
clear;
close;
```

```
format('v',7);
//Given data :
D1=800/1000;//m^2
D2=600/1000;//m^2
p1=100;//kPa
p2=40;//kPa
v1=4000*10^-3;//m/s
A1=%pi*D1^2/4;//m^2
A2=%pi*D2^2/4;//m^2
Z1=4;//meter
Z2=7;//meter
rho=1;//sp. gravity
g=9.81;//constant
PHeadA=p1/rho/g;//meter of fluid
PHeadB=p2/rho/g;//meter of fluid
v2=A1*v1/A2;//m/s
VHeadA=v1^2/2/g;//meter
VHeadB=v2^2/2/g;//meter
E1=Z1+PHeadA+VHeadA;//meter
E2=Z2+PHeadB+VHeadB;//meter
if E1>E2 then
    disp("Total Energy at A("+string(E1)+" meter) is
        greater than total energy at B("+string(E2)+
       " meter). Flow of water is from A to B.");
else
        disp("Total Energy at B("+string(E2)+" meter
           ) is greater than total energy at A("+
           string(E1)+" meter). Flow of water is
           from B to A.");
end
```

Scilab code Exa 5.6 Pressure at the low end

```
//Example 5.6
clc;
```

```
clear;
close;
format('v',8);
//Given data :
D1=1.25;//meter
D2=0.625;//meter
slope=100;
L=300;///meter
g=9.81;//constant
Z12=L/slope;//meter
Q=100;//litres/sec
Q=Q*10^-3;//m^3/sec
A1=%pi*D1^2/4;//m^2
A2=%pi*D2^2/4;//m^2
v1=Q/A1;//m/s
v2=Q/A2;//m/s
p1=100;//kN/m^2
//Higher End :
w=9.81;//kN/m^3
Phead=p1/w;//meter
Vhead=v1^2/2/g;//meter
//Lower End :
w=9.81;//kN/m^3
//Phead=p1/w;//meter
Vhead=v2^2/2/g;//meter
p2=(Z12+v1^2/2/g+p1/w-v2^2/2/g)*w;//kN/m^2(By
    Bernoulli's theorem)
disp(p2,"Pressure at the lower end in kN per m^2 : "
    );
```

Scilab code Exa 5.7 Loss of head and direction of flow

```
//Example 5.7
clc;
clear;
```

```
close;
format('v',8);
//Given data :
Z1=0;//meter
Z2=5;//meter
Q=300*10^-3;//m/s
D1=0.3;//meter
D2=0.6;//meter
A1=%pi*D1^2/4;//m^2
A2=%pi*D2^2/4;//m^2
v1=Q/A1;//m/s
v2=Q/A2;//m/s
p1=100;//kN/m^2
p2=600;//kN/m^2
g=9.81;//constant
Vhead11=v1^2/2/g;//meter
Vhead22=v2^2/2/g;//meter
Phead11=p1/g;//meter
Phead22=p2/g;//meter
E1_11=Z1+Vhead11+Phead11;//meter
E2_22=Z2+Vhead22+Phead22;//meter
if E1_11>E2_22 then
    disp("Energy at section 1-1("+string(E1_11)+" meter) is greater than energy at section 2-2("+string(E2_22)+" meter). Flow of water is from section 1-1 to 2-2.");
    HeadLoss=E1_11-E2_22;//meter
    disp(HeadLoss,"Head Loss in meter : ");
else
        disp("Energy at section 2-2("+string(E2_22)+" meter) is greater than energy at section 1-1("+string(E1_11)+" meter). Flow of water is from section 2-2 to 1-1.");
          HeadLoss=E2_22-E1_11;//meter
        disp(HeadLoss,"Head Loss in meter : ");
end
```

Scilab code Exa 5.8 Find Loss of head

```
//Example 5.8
clc;
clear;
close;
format('v',8);
//Given data :
D=400/1000;//meter
v1=20;//m/s
Z1=28;//meter
Z2=31;//meter
p1=4/10^-4;//kg/m^2
p2=3/10^-4;//kg/m^2
g=9.81;//constant
w=1000;//kg/m^3
Vhead1=v1^2/2/g;//meter
Phead1=p1/w;//meter
Vhead2=Vhead1;//meter
Phead2=p2/w;//meter
E1=Z1+Vhead1+Phead1;//meter
E2=Z2+Vhead2+Phead2;//meter
HL=E1-E2;//meter
disp(HL,"Loss of head between P & Q in meter : ");
```

Scilab code Exa 5.9 Head Loss and direction of flow

```
//Example 5.9
clc;
clear;
close;
format('v',8);
```

```
//Given data :
Z1=0;//meter
Z2=4;//meter
rho=0.8;//sp. gravity

Q=250*10^-3;//m/s or cumec
D1=250/1000;//meter
D2=500/1000;//meter
A1=%pi*D1^2/4;//m^2
A2=%pi*D2^2/4;//m^2
v1=Q/A1;//m/s
v2=Q/A2;//m/s
p1=0.1*10^3;//N/m^2
p2=0.06*10^3;//N/m^2
g=9.81;//constant
Vhead1=v1^2/2/g;//meter
Phead1=p1/rho/g;//meter
Vhead2=v2^2/2/g;//meter
Phead2=p2/rho/g;//meter
H1=Z1+Vhead1+Phead1;//meter
H2=Z2+Vhead2+Phead2;//meter
if H1>H2 then
    disp("Total head at A("+string(H1)+" meter) is
       greater than total head at B("+string(H2)+"
       meter). Flow will take place from A-B.");
    HeadLoss=H1-H2;//meter
    disp(HeadLoss,"Head Loss in meter : ");
else
    disp("Total head at B("+string(H2)+" meter) is
       greater than total head at A("+string(H1)+"
       meter). Flow will take place from B-A.");
    HeadLoss=H2-H1;//meter
    disp(HeadLoss,"Head Loss in meter : ");end
```

Scilab code Exa 5.10 Determine pressure intensity

```
//Example 5.10
clc;
clear;
close;
format('v',8);
//Given data :
Q=200*10^-3;//m^3/s
D1=250/1000;//meter
D2=200/1000;//meter
A1=%pi*D1^2/4;//m^2
A2=%pi*D2^2/4;//m^2
v1=Q/A1;//m/s
v2=Q/A2;//m/s
Z1=2;//meter
Z2=8;//meter
g=9.81;//constant
w=1000;//kg/m^3
p1=w*(Z1-v1^2/2/g);//kg/m^2
p2=v1^2/2/g*w+p1+Z2*w-v2^2/2/g*w-4*w;//kg/m^2(by
    Bernolli's theorem)
p1=p1*g;//N/m^2
p2=p2*g;//N/m^2
disp(p1,"Pressure intensity at point P in N/m^2 : ")
    ;
disp(p2,"Pressure intensity at point Q in N/m^2 : ")
    ;
//Answer in the book is not accurate.
```

Scilab code Exa 5.11 Intensity of pressure and discharge

```
//Example 5.11
clc;
clear;
close;
format('v',8);
```

```
//Given data :
slope=1/10;
Z1=0;//meter
Z2=40*slope;//meter
p1=1.5/10^-4;//kg/cm^2
v2=4.1;//m/s
D1=600/1000;//meter
D2=300/1000;//meter
A1=%pi*D1^2/4;//m^2
A2=%pi*D2^2/4;//m^2
v1=A2*v2/A1;//m/s
g=9.81;//constant
w=1000;//kg/m^3
p2=(p1/w+v1^2/2/g+Z1-v2^2/2/g-Z2)*w;//kg/m^2(by Bernolli's theorem)
p2=p2*10^-4;//kg/cm^2
Q1=A1*v1;//m^3/sec
Q1=Q1*1000;//litre/sec
disp(p2,"Pressure intensity at point Q in kg/cm^2 : ");
disp(Q1,"Discharge of pipe in litres/sec : ");
//Answer in the book is not accurate. calculation for A1 & A2 is wrong.
```

Scilab code Exa 5.12 Find discharge of oil

```
//Example 5.12
clc;
clear;
close;
format('v',6);
//Given data :
D1=180/1000;//meter
D2=90/1000;//meter
g=9.81;//gravity constant
```

```
S=0.8;//sp. gravity of oil
Sm=13.6;//sp. gravity of mercury
x=300/1000;//meter
K=0.97;//coeff. of meter
A1=%pi*D1^2/4;//m^2
A2=%pi*D2^2/4;//m^2
C=A1*A2*sqrt(2*g)/sqrt(A1^2-A2^2)
h=x*(Sm/S-1);//meter of oil
Q=K*C*sqrt(h);//m^3/sec
Q=Q*1000;//litre/sec
disp(Q,"Discharge of oil in litres/sec : ");
```

Scilab code Exa 5.13 Coefficient of meter

```
//Example 5.13
clc;
clear;
close;
format('v',8);
//Given data :
D1byD2=1/0.7;
D1=320/1000;//meter
D2=320*0.7/1000;//meter
g=9.81;//gravity constant
Q=30.6/60;//m^3/sec
A1=%pi*D1^2/4;//m^2
A2=%pi*D2^2/4;//m^2
C=A1*sqrt(2*g)/sqrt((D1byD2)^4-1);
h=1.2;//meter of water
K=Q/C/sqrt(h);//Coeff. of meter
disp(K,"Coefficient of meter : ");
//Answer in the book is wrong.
```

Scilab code Exa 5.14 Deflection in manometer

```
//Example 5.14
clc;
clear;
close;
format('v',5);
//Given data :
D1=320/1000;//meter
D2=224/1000;//meter
g=9.81;//gravity constant
Q=25000/1000/60;//m^3/sec
A1=%pi*D1^2/4;//m^2
A2=%pi*D2^2/4;//m^2
C=0.4984;//venturi constant
K=0.92;//Coeff. of meter
h=(Q/K/C)^2
S=1;//sp. gravity
Sm=13.6;//sp. gravity
x=h/(Sm/S-1);//meter of water
disp(x*1000,"Deflection in  manometer(mm) : ");
```

Scilab code Exa 5.15 Find pressure difference

```
//Example 5.15
clc;
clear;
close;
format('v',6);
//Given data :
D1=120/1000;//meter
D2=120*0.55/1000;//meter
g=9.81;//gravity constant
A1=%pi*D1^2/4;//m^2
A2=%pi*D2^2/4;//m^2
```

```
Q=30/1000;//m^3/sec
C=A1*sqrt(2*g)/sqrt((D1/D2)^4-1);//venturi constant
K=0.94;//Coeff. of meter
h=(Q/K/C)^2;//meter
Z1=0;//meter
Z2=0.3;//meter
S=0.79;//sp. gravity
w=1000*S;//kg/m^3
delta_p=(h+Z1-Z2)*w;//kg/m^2
delta_p=delta_p*g;//N/m^2
disp(delta_p,"Pressure difference in N/m^2 : ");
//answer is wrong in the book.
```

Scilab code Exa 5.16 Deflection of oil mercury gauge

```
//Example 5.16
clc;
clear;
close;
format('v',6);
//Given data :
D1=160/1000;//meter
D2=60/1000;//meter
g=9.81;//gravity constant
S=0.8;//sp. gravity
Sm=13.6;//sp. gravity of mercury
Q=0.05;//m^3/sec
K=0.98;//Coeff. of meter
A1=%pi*D1^2/4;//m^2
A2=%pi*D2^2/4;//m^2
C=A1*sqrt(2*g)/sqrt((A1/A2)^2-1);//venturi constant
h=(Q/K/C)^2;//meter
x=h/(Sm/S-1);//meter
disp(x,"Deflection in meter : ");
```

Scilab code Exa 5.17 Rate of flow

```
//Example 5.17
clc;
clear;
close;
format('v',4);
//Given data :
D1=200/1000;//meter
D2=100/1000;//meter
x=220/1000;//meter
g=9.81;//gravity constant
K=0.98;//Coeff. of meter
S=1;//sp. gravity
Sm=13.6;//sp. gravity of mercury
A1=%pi*D1^2/4;//m^2
A2=%pi*D2^2/4;//m^2
C=A1*sqrt(2*g)/sqrt((A1/A2)^2-1);//venturi constant
h=x*(Sm/S-1);//meter
Q=K*C*sqrt(h);//m^3/sec
Q=Q*1000;//litres/sec
disp(Q,"Rate of flow in litres/sec : ");
```

Scilab code Exa 5.18 Calculate flow water

```
//Example 5.18
clc;
clear;
close;
format('v',8);
//Given data :
D1=40/100;//meter
```

```
D2=15/100;//meter
x=25/100;//meter
g=9.81;//gravity constant
K=0.98;//Coeff. of meter
S=1;//sp. gravity
Sm=13.6;//sp. gravity of mercury
A1=%pi*D1^2/4;//m^2
A2=%pi*D2^2/4;//m^2
C=A1*A2*sqrt(2*g)/sqrt(A1^2-A2^2);//venturi constant
h=x*(Sm/S-1);//meter
Q=K*C*sqrt(h);//m^3/sec
Q=Q*1000*3600;//litres/hour
disp(Q,"Flow of water in litres/hour : ");
//Answer in the book is wrong.
```

Scilab code Exa 5.19 Flow rate of water

```
//Example 5.19
clc;
clear;
close;
format('v',4);
//Given data :
D1=15/100;//meter
D2=7.5/100;//meter
g=9.81;//gravity constant
p1=4*g*10^4;//N/m^2
p2=1.5*g*10^4;//kg/cm^2
w=9.81;//kg/m^2
A1=%pi*D1^2/4;//m^2
A2=%pi*D2^2/4;//m^2
v1BYv2=A2/A1;
//v1^2/2/g+p1/w=v2^2/2/g+p2/w
//v1^2=v2^2-50*g
v2=sqrt(50*g/(1-v1BYv2^2));//m/s
```

```
Q=A2*v2;//m^3/sec
Q=Q*1000;//litres/sec
disp(Q,"Flow of water in litres/sec : ");
//Answer is wrong in the book.
```

Scilab code Exa 5.20 Velocity and flow rate

```
//Example 5.20
clc;
clear;
close;
format('v',6);
//Given data :
D1=20/100;//meter
D2=15/100;//meter
A1=%pi/4*D1^2;//m^2
A2=%pi/4*D2^2;//m^2
v1=2;//m/s
v2=A1*v1/A2;//m/s
disp(v2,"Velocity at another section in m/s : ");
FlowRate=A1*v1;//m^3/s
FlowRate=FlowRate*1000;//litres/s
disp(FlowRate,"Flow Rate in litres/sec : ");
//Answer of velocity in the book is not accurate.
```

Scilab code Exa 5.21 Flow rate of oil

```
//Example 5.21
clc;
clear;
close;
format('v',4);
//Given data :
```

```
rd=0.75;//relative density
D=12.5/100;//meter
p=1;//bar
p=p*1.02;//kg/cm^2
p=p*9.81*10^4/1000;//kPa
g=9.81;//gravity constant
w=g*rd;//N/m^3
pH=p/w;//meter
Z=2.5;//meter
Et=20;//Nm
v=sqrt((Et-p/w-Z)*2*g);//m/s
A=%pi/4*D^2;//m^2
Q=A*v;//m^3/sec
Q=A*v*1000;//litres/sec
disp(Q,"Flow Rate of oil in litres/sec : ");
```

Scilab code Exa 5.22 Find Z

```
//Example 5.22
clc;
clear;
close;
format('v',5);
//Given data :
rd=0.75;//relative density
d1=0.3;//meter
d2=0.1;//meter
Q=50/1000;//m^3/sec
A1=%pi/4*d1^2;//m^2
A2=%pi/4*d2^2;//m^2
v1=Q/A1;//m/s
v2=A1*v1/A2;//m/s
p1=200;//kN/m^2
p2=100;//kN/m^2
w=9.81;//kN/m^3
```

```
g=9.81;//gravity constant
Z1=0;//meter
Z2=Z1+p1/w+v1^2/2/g-p2/w-v2^2/2/g;//meter
disp(Z2,"Z in meter : ");
```

Scilab code Exa 5.23 Discharge in the pipe

```
//Example 5.23
clc;
clear;
close;
format('v',6);
//Given data :
D1=300/1000;//meter
D2=150/1000;//meter
Q=50/1000;//m^3/sec
A1=%pi/4*D1^2;//m^2
A2=%pi/4*D2^2;//m^2
delpBYw=3;//p1/w-p2/w=3;//m
v1BYv2=A2/A1;
Z1=0;//meter
Z2=0;//meter
g=9.81;//gravity constant
//HeadLoss=1/8*v^2/2/g
//Z1+p1/w+v1^2/2/g=Z2+p2/w+v2^2/2/g+HeadLoss
v2=sqrt((Z1-Z2+delpBYw)/(1/2/g-v1BYv2^2/2/g+1/8/2/g)
    );//m/s
Q=A2*v2;//m^3/s
Q=Q*1000;//litres/sec
disp(Q,"Discharge in pipe in litres/sec : ");
```

Chapter 6

Orifices

Scilab code Exa 6.1 Calculate Coefficients

```
//Example 6.1
clc;
clear;
close;
format('v',5);
//Given data :
Do=25;//mm
Dc=20;//mm
H=85;//mm
x=335;//mm
y=350;//mm
a=%pi/4*Do^2;//m^2
ac=%pi/4*Dc^2;//m^2
Cc=ac/a;
disp(Cc,"Coefficient of contraction : ");
Cv=sqrt(x^2/4/H/y);
disp(Cv,"Coefficient of velocity : ");
Cd=Cc*Cv;
disp(Cd,"Coefficient of discharge : ");
Cr=(1/Cv^2-1);
disp(Cr,"Coefficient of resistance : ");
```

Scilab code Exa 6.2 Calculate various Coefficients

```
//Example 6.2
clc;
clear;
close;
format('v',5);
//Given data :
Do=0.125;//m
H=10.5;//mm
Q=6500;//litres/minute
Q=Q/60/1000;//cumec
x=6;//m
y=1;//m
g=9.81;//gravity constant
a=%pi/4*Do^2;//m^2
Qth=a*sqrt(2*g*H);//cumec
Cd=Q/Qth;//
disp(Cd,"Coefficient of discharge : ");
Cv=sqrt(x^2/4/H/y);
format('v',6);
disp(Cv,"Coefficient of velocity : ");
Cc=Cd/Cv;
format('v',5);
disp(Cc,"Coefficient of contraction : ");
Cr=(1/Cv^2-1);
format('v',6);
disp(Cr,"Coefficient of resistance : ");
```

Scilab code Exa 6.3 Coefficient of velocity

```
//Example 6.3
clc;
clear;
close;
format('v',5);
//Given data :
g=9.81;//constant
h=102;//mm
H=105;//mm
Cv=sqrt(2*g*h)/sqrt(2*g*H);
disp(Cv,"Coefficient of velocity : ");
```

Scilab code Exa 6.4 Coefficient of velocity

```
//Example 6.4
clc;
clear;
close;
format('v',5);
//Given data :
Q=180/62;//litres/sec
Q=Q/1000;//cumec
Dc=25/1000;//m
H=1.9;//m
ac=%pi/4*Dc^2;//m^2
g=9.81;//constant
Cv=Q/sqrt(2*g*H)/ac;
disp(Cv,"Coefficient of velocity : ");
```

Scilab code Exa 6.5 Various hydraulic coefficients

```
//Example 6.5
clc;
```

```
clear;
close;
format('v',6);
//Given data :
g=9.81;//constant
d=30/1000;//meter
wl=2;//kgm
w1=148.6/60;//kg/sec
y=1.65;//meter
H=1.3;//meter
Cv=wl/w1/y*sqrt(g)/sqrt(2*H);
disp(Cv,"Coefficient of velocity : ");
Q=w1/1000;//Cumec
a=%pi/4*d^2;//meter^2
Qth=a*sqrt(2*g*H);//Cumec
Cd=Q/Qth;//coeff. of discharge
disp(Cd,"Coefficient of discharge : ");
Cc=Cd/Cv;//coeff. of contraction
format('v',5);
disp(Cc,"Coefficient of contraction : ");
//Answer in the book are not accurate.
```

Scilab code Exa 6.6 Various hydraulic coefficients

```
//Example 6.6
clc;
clear;
close;
format('v',7);
//Given data :
g=9.81;//constant
a=9*10^-4;//m^2
H=3;//meter
x=2.5;//meter
y=54/100;//meter
```

```
Qactual=250*10^-3/60;//Cumec
Qth=a*sqrt(2*g*H);//Cumec
Cd=Qactual/Qth;//coeff. of discharge
disp(Cd,"Coefficient of discharge : ");
Cv=sqrt(x^2)/sqrt(4*H*y);//velocity
disp(Cv,"Coefficient of velocity : ");
Cc=Cd/Cv;//coeff. of contraction
disp(Cc,"Coefficient of contraction : ");
//Answer in the book are not accurate.
```

Scilab code Exa 6.7 Coefficient of discharge

```
//Example 6.7
clc;
clear;
close;
format('v',5);
//Given data :
g=9.81;//constant
d=20/1000;//meter
a=%pi/4*d^2;//m^2
H=1;//meter
Qactual=0.85*10^-3;//m^3/sec
v=sqrt(2*g*H);//m/sec
Qth=a*v;//Cumec
Cd=Qactual/Qth;//coeff. of discharge
disp(Cd,"Coefficient of discharge : ");
```

Scilab code Exa 6.8 Coefficients of orifice

```
//Example 6.8
clc;
clear;
```

```
close;
format('v',6);
//Given data :
g=9.81;//constant
d=1.5;//meter
h=1;//meter
Volume=%pi/4*d^2*h;//m^3
time=25;//sec
Qactual=Volume/time;//Cumec
H=10;//meter
do=10/100;//meter
x=4.3;//meter
y=0.5;//meter
ao=%pi/4*do^2;//m^2
Qth=ao*sqrt(2*g*H);//cumec
Cd=Qactual/Qth;//Coeff. ofdischarge
disp(Cd,"Coefficient of discharge : ");
format('v',5);
Cv=sqrt(x^2)/sqrt(4*H*y);//Coefficient of velocity
disp(Cv,"Coefficient of velocity : ");
Cc=Cd/Cv;//coeff. of contraction
disp(Cc,"Coefficient of contraction : ");
Cr_dash=(1/Cv^2-1);//coeff. of resistance
disp(Cr_dash,"Coefficient. of Resistance");
```

Scilab code Exa 6.9 Various hydraulic coefficients

```
//Example 6.9
clc;
clear;
close;
format('v',5);
//Given data :
g=9.81;//constant
do=2.5/100;//meter
```

```
H=75/100;//meter
x=30/100;//meter
y=3.2/100;//meter
Qactual=1.186*10^-3;//Cumec
ao=%pi/4*do^2;//m^2
Qth=ao*sqrt(2*g*H);//cumec
Cd=Qactual/Qth;//Coeff. ofdischarge
disp(Cd,"Coefficient of discharge : ");
Cv=sqrt(x^2)/sqrt(4*H*y);//Coefficient of velocity
format('v',7);
disp(Cv,"Coefficient of velocity : ");
format('v',6);
Cc=Cd/Cv;//coeff. of contraction
disp(Cc,"Coefficient of contraction : ");
Cr_dash=(1/Cv^2-1);//coeff. of resistance
disp(Cr_dash,"Coefficient. of Resistance");
//Answers in the book are not accurate.
```

Scilab code Exa 6.10 Meeting point of two jets

```
//Example 6.10
clc;
clear;
close;
format('v',5);
//Given data :
g=9.81;//constant
H1=4-1;//meter
H2=4;//meter
Cv1=0.9;//Coefficient of velocity
Cv2=0.9;//Coefficient of velocity
//Cv1=Cv2 & x1=x2 at meeting point
//x1/sqrt(4*H1*y1)=x2/sqrt(4*H2*y2)
y1BYy2=H2/H1;
//y1=1+y2;
```

```
y2=1/(y1BYy2-1);//meter
y1=y1BYy2*y2;//meter
x1=Cv1*sqrt(4*H1*y1);//meter
disp(y1,x1,"Meeting point horizontal & vertical co-ordinates are(x1 & y1 in meter) : ");
//Answer in the book are not accurate.
```

Scilab code Exa 6.11 Discharge through the orifice

```
//Example 6.11
clc;
clear;
close;
format('v',8);
//Given data :
g=9.81;//constant
Cd=0.6;//Coefficient of discharge
B=1.3;//meter
H1=6-(1.8+1.5);//meter
H2=6-1.5;//meter
Q=2/3*Cd*B*sqrt(2*g)*(H2^(3/2)-H1^(3/2));//m^3/sec
disp(Q,"Discharge through the orifice in m^3/sec : ");
```

Scilab code Exa 6.12 Discharge through orifice

```
//Example 6.12
clc;
clear;
close;
format('v',7);
//Given data :
g=9.81;//constant
```

```
Cd=0.62;//Coefficient of discharge
B=2;//meter
H1=3;//meter
H2=3+1.5;//meter
Q=2/3*Cd*B*sqrt(2*g)*(H2^(3/2)-H1^(3/2));//m^3/sec
    or cumec
disp(Q,"Discharge through the orifice in cumec : ");
```

Scilab code Exa 6.13 Calculate percentage error

```
//Example 6.13
clc;
clear;
close;
format('v',7);
//Given data :
g=9.81;//constant
Cd=0.6;//Coefficient of discharge
B=1.6;//meter
H1=1500/1000;//meter
H2=(1500+1250)/1000;//meter
Q=2/3*Cd*B*sqrt(2*g)*(H2^(3/2)-H1^(3/2));//m^3/sec
    or cumec
disp(Q,"Discharge through the opening in cumec : ");
//For small opening
H=1.5+1.25/2;//meter
D=1.25;//meter
Qdash=Cd*(B*D)*sqrt(2*g*H);//cumec
Error=(Qdash-Q)/Q*100;//%
disp(Error,"% of error : ");
//Answer is wrong in the book.
```

Scilab code Exa 6.14 Discharge through orifice

```
//Example 6.14
clc;
clear;
close;
format('v',6);
//Given data :
g=9.81;//constant
Cd=0.6;//Coefficient of discharge
B=1600/1000;//meter
D=1250/1000;//meter
ao=1.6*1.25;//m^2
H1=2+1.25/2;//meter
H2=0.8+1.25/2;//meter
H=H1-H2;//meter
Q=Cd*ao*sqrt(2*g*H);//m^3/sec or Cumec
disp(Q,"Discharge in Cumec : ");
//Answer is wrong in the book.
```

Scilab code Exa 6.15 Discharge through orifice

```
//Example 6.15
clc;
clear;
close;
format('v',5);
//Given data :
g=9.81;//constant
Cd=0.6;//Coefficient of discharge
B=1600/1000;//meter
D=1250/1000;//meter
ao=1.6*1.25;//m^2
H1=2+1.25;//meter
H2=2;//meter
H=H1-0.8;//meter
Q=2/3*Cd*B*sqrt(2*g)*(H^(3/2)-H2^(3/2))+Cd*B*(H1-H)*
```

```
    sqrt(2*g*H);//m^3/sec or Cumec
disp(Q,"Discharge through the orifice in Cumec : ");
```

Scilab code Exa 6.16 Find time taken

```
//Example 6.16
clc;
clear;
close;
format('v',6);
//Given data :
g=9.81;//constant
d=4;//meter
d0=0.5;//meter
H1=5;//meter
H2=2;//meter
Cd=0.6;//Coefficient of discharge
ao=%pi/4*d0^2;//m^2
A=%pi/4*d^2;//m^2
t=2*A/Cd/ao/sqrt(2*g)*(sqrt(H1)-sqrt(H2))
disp(t,"Time taken to fall from 5m to 2m(in seconds)
    : ");
//For emptying H2=0;
H2=0;//meter
t=2*A/Cd/ao/sqrt(2*g)*(sqrt(H1)-sqrt(H2))
disp(t,"Time taken for completely emptying(in
    seconds) : ");
```

Scilab code Exa 6.17 Time of emptying the tank

```
//Example 6.17
clc;
clear;
```

```
close;
format('v',5);
//Given data :
g=9.81;//constant
d=1.2;//meter
do=50/1000;//meter
H=3;//meter
Cd=0.6;//Coefficient of discharge
ao=%pi/4*do^2;//m^2
A=%pi/4*d^2;//m^2
t=2*A*sqrt(H)/Cd/ao/sqrt(2*g);//sec
disp("Time taken for emptying the tank is "+string(
    floor(t/60))+" minute "+string((t/60-floor(t/60))
    *60)+" seconds.");
```

Scilab code Exa 6.18 Time required to bring down the level

```
//Example 6.18
clc;
clear;
close;
format('v',4);
//Given data :
g=9.81;//constant
A=3.2;//m^2
a=10*10^-4;//m^2
H1=5;//meter
H2=2.5;//meter
Cd=0.6;//Coefficient of discharge
t=2*A*(sqrt(H1)-sqrt(H2))/Cd/a/sqrt(2*g);//sec
disp("Time taken is "+string(floor(t/60))+" minute "
    +string((t/60-floor(t/60))*60)+" seconds.");
```

Scilab code Exa 6.19 Time required to empty the tank

```
//Example 6.19
clc;
clear;
close;
format('v',4);
//Given data :
g=9.81;//constant
A=3.2;//m^2
a=10*10^-4;//m^2
H=5;//meter
Cd=0.6;//Coefficient of discharge
t=2*A*sqrt(H)/Cd/a/sqrt(2*g);//sec
disp("Time taken is "+string(floor(t/3600))+" hour "
    +string(floor((t/3600-floor(t/3600))*60))+"
    minute "+string(((t/3600-floor(t/3600))*60-floor
    ((t/3600-floor(t/3600))*60))*60)+" seconds.");
```

Chapter 7

Flow through pipes

Scilab code Exa 7.1 Relation between CGS and MKS unit

```
//Example 7.1
clc;
clear;
close;
format('v',9);
disp("Part(i)");
disp("Absolute unit of viscosity(in C.G.S) is Poise.");
disp("Poise=1 dyne-sec/cm^2");
disp("Gravitational unit of viscosity is 1 gm-sec/cm^2.");
disp("On equating we get, 1 gm = 981 dyne");
//Let x=1kg-sec/m^2
x=1*10^3/10^4;//g-sec/cm^2
x=x*981;//dyne-sec/cm^2 or Poise(Putting 1gm=981 dyne)
disp("1 kg-sec/m^2 = "+string(x)+" Poise");
one_Poise=1/x;//kg-sec/m^2
one_Poise=1/x*9.81;//N-sec/m^2 or Pa-sec(as 1Pa=1N/m^2)
disp("1 Poise = "+string(one_Poise)+" N-sec/m^2 or
```

```
   Pa−sec");
disp("Part(ii)");
disp("Kinematic viscosity = viscosity/
   specific_gravity");
disp("Kinematic viscosity C.G.S unit is cm^2/sec. 1
   cm^2/sec=1stoke");
disp("Kinematic viscosity M.K.S unit is m^2/sec");
//let x=1;//m^2/sec
x=1;//m^2/sec
x=x*10^4;//cm^2/sec or stokes
disp("1 m^2/sec = "+string(x)+" cm^2/sec or stoke");
one_stoke=1/x;//m^2/sec
disp("1 stoke = "+string(one_stoke)+" m^2/sec");
disp("1 stoke = 100 centi−stokes");
```

Scilab code Exa 7.2 Kinematic viscosity and Reynolds number

```
//Example 7.2
clc;
clear;
close;
format('v',7);
//Given data :
mu=0.009;//kg−sec/m^2
rho=0.89;//sp. gravity
Q=4*10^-3;//m^3/sec
d=30/1000;//meter
v=mu/rho;//m^2/s
disp(v,"Kinematic viscosity in m^2/sec : ");
A=%pi*d^2/4;//m^2
vm=Q/A;//m/s
Rn=vm*d/v;//Reynolds no.
disp(Rn,"Reynolds number for flow  : ");
disp("This is laminar flow because Rn no. is less
   than 2000.");
```

Scilab code Exa 7.3 Calculate reynolds number

```
//Example 7.3
clc;
clear;
close;
format('v',7);
//Given data :
d=200/1000;//meter
Q=40*10^-3;//m^3/sec
A=%pi*d^2/4;//m^2
vm=Q/A;//m/s
v=0.25*10^-4;//m^2/s
Rn=vm*d/v;//Reynolds no.
disp(Rn,"Reynolds number for flow  : ");
disp("This is turbulent flow because Rn no. is
   greater than 4000.");
disp(Rn/8,"New Reynolds number for flow  : ");
disp("This is laminar flow because Rn no. is less
   than 2000.");
```

Scilab code Exa 7.4 Head Lost due to friction

```
//Example 7.4
clc;
clear;
close;
format('v',7);
//Given data :
D=30/100;//meter
L=100;//meter
```

```
v=0.01*10^-4;//m^2/s
a=3;//m/s
g=9.81;//gravity constanty
Rn=a*D/v;//Reynolds no.
f=0.079/Rn^(1/4);//using blasius formula
hf=4*f*L/D*a^2/2/g;//meter
disp(hf,"Head lost in meter : ");
//Answer in the book is wrong.
```

Scilab code Exa 7.5 Difference in elevations

```
////Example 7.5
clc;
clear;
close;
format('v',6);
//Given data :
D=30/100;//meter
L=500;//meter
Q=300*10^-3;//m^2/sec
f=0.0008;//coeff. of friction
v=Q/(%pi/4*D^2);//m/s
g=9.81;//gravity constanty
hf=4*f*L*v^2/D/2/g;//meter
disp(hf,"Difference in elevation in meter : ");
//Answer in the book is wrong.
```

Scilab code Exa 7.6 Head Lost due to friction

```
////Example 7.6
clc;
clear;
close;
```

```
format('v',6);
//Given data :
D=20/100;//meter
v=3;//m/s
v1=0.01*10^-3;//m^2/sec
Re=D*v/v1;//Reynolds number
f=0.002+0.09/Re^0.3;//coeff. of friction
L=5;//meter
g=9.81;//gravity constanty
hf=4*f*L*v^2/D/2/g;//meter
disp(hf,"Head lost due to friction in meter : ");
```

Scilab code Exa 7.7 Loss of head due to friction

```
////Example 7.7
clc;
clear;
close;
format('v',6);
//Given data :
D=80/1000;//meter
Q=600*10^-3/60;//m^3/sec
L=1*10^3;//meter
f=0.02;//coefficient of friction
v=Q/(%pi/4*D^2);//m/s
g=9.81;//gravity constanty
hf=4*f*L*v^2/D/2/g;//meter
disp(hf,"Head lost due to friction in meter : ");
//Answer is wrong in the book.
```

Scilab code Exa 7.8 Various losses

```
////Example 7.8
```

```
clc;
clear;
close;
format('v',6);
//Given data :
g=9.81;//gravity constanty
f=0.02;//coefficient of friction
Cc=0.62;//coefficient of contraction
//Portion AB
Q1=50*10^-3;//m^3/sec
D1=150/1000;//meter
v1=Q1/(%pi/4*D1^2);//m/s
hr=0.5*v1^2/2/g;//meter
L1=200;//meter
hf1=4*f*L1*v1^2/2/g/D1;//meter
D2=200/1000;//meter
v2=Q1/(%pi/4*D2^2);//m/s
hc1=(v1-v2)^2/2/g;//meter
L2=500;//meter
hf2=4*f*L2*v2^2/2/g/D2;//meter
d=75/1000;//meter
ho=[(%pi/4*D2^2)/Cc/((%pi/4*D2^2)-(%pi/4*d^2))-1]^2*
    v2^2/2/g;//meter
D3=120/1000;//meter
v3=Q1/(%pi/4*D3^2);//m/s
hc2=v3^2/2/g*(1/Cc-1)^2;//meter
L3=500;//meter
hf3=4*f*L3*v3^2/2/g/D3;//meter
Kb=0.25;//assumed
hb1=Kb*v3^2/2/g;//meter
D4=120/1000;//meter
v4=Q1/(%pi/4*D4^2);//m/s
L4=500;//meter
hf4=4*f*L4*v4^2/2/g/D4;//meter
hb2=Kb*v3^2/2/g;//meter
L5=500;//meter
hf5=4*f*L5*v4^2/2/g/D4;//meter
h_outlet=v3^2/2/g;//meter
```

```
h_total=hr+hf1+hc1+hf2+ho+hc2+hf3+hb1+hf4+hb2+hf5+
    h_outlet;//meter
disp(h_total,"Total loss of head in meter : ");
```

Scilab code Exa 7.9 Intensity of pressure

```
////Example 7.9
clc;
clear;
close;
format('v',7);
//Given data :
g=9.81;//gravity constanty
Cc=0.62;//coefficient of contraction
D1=150/1000;//meter
D2=100/1000;//meter
Q=2.7/60;//m^3/sec
p1=0.8*10^4;//kg/m^2
v1=Q/(%pi/4*D1^2);//m/s
v2=Q/(%pi/4*D2^2);//m/s
hc=v2^2/2/g*(1/Cc-1)^2;//meter
w=1000;//kg/m^3
p2=(v1^2/2/g+p1/w-v2^2/2/g-hc)*w;//kg/m^2(Z1=Z2)
p2=p2*10^-4;//kg/cm^2
disp(p2,"Intensity of pressure in kg/cm^2 : ");
```

Scilab code Exa 7.10 Diameter of pipe

```
////Example 7.10
clc;
clear;
close;
format('v',5);
```

```
//Given data :
g=9.81;//gravity constanty
L=3*1000;//meter
hf=20;//meter
Q=1;//m^3/sec
f=0.02;//coeff. of friction
//v=sqrt(hf*2*g/4/f/L/D);//it is v^2*D
D2v=Q/(%pi/4);//it is D^2*v
D=(Q/(%pi/4)/sqrt(hf*2*g/4/f/L))^(2/5);//meter
D=D*1000;//mm
disp(D,"Diameter of pipe in mm  : ");
```

Scilab code Exa 7.11.a Discharge and velocity

```
////Example 7.11 at page 246
clc;
clear;
close;
format('v',7);
//Given data :
g=9.81;//gravity constanty
D1=400/1000;//meter
D2=300/1000;//meter
D3=200/1000;//meter
v1=3;//m/s
v2=2;//m/s
A1=%pi/4*D1^2;//m^2
A2=%pi/4*D2^2;//m^2
A3=%pi/4*D3^2;//m^2
Q1=A1*v1;//cumec
disp(Q1,"Discharge in pipe 1 in cumec : ");
Q2=A2*v2;//cumec
Q3=Q1-Q2;//cumec
v3=Q3/A3;//m/s
disp(v3,"Velocity of water in 200mm pipe in m/s : ")
```

;

Scilab code Exa 7.11 Calculate the pressure

```
////Example 7.11
clc;
clear;
close;
format('v',7);
//Given data :
g=9.81;//gravity constanty
D1=100/1000;//meter
D2=200/1000;//meter
PQ=100;//meter
QR=100;//meter
slope=1/100;//upward slope
Q=0.02;//cumec
p1=2;//kg/cm^2(Pressure in 100 mm dia pipe)
f=0.02;//unitless
Q_P=100/100;//meter(Point Q hight respect to point P
    )
Q_R=200/100;//meter(Point Q hight respect to point R
    )
v1=Q/(%pi/4*D1^2);//m/sec
v2=Q/(%pi/4*D2^2);//m/sec
hf1=4*f*PQ*v1^2/(2*g*D1);//meter
hf2=4*f*QR*v2^2/(2*g*D2);//meter
hse=(v1-v2)^2/2/g;//meter(loss due to sudden
    enlargement)
//Section PQ
Z1P=0;//meter(Datum Head)
H1P=v1^2/2/g;//meter(velocity Head)
p1BYw=p1*10^4/1000;//meter(Pressure Head at P)
Z1Q=1;//meter(Datum Head)
H1Q=v2^2/2/g;//meter(velocity Head)
```

```
//Applying bernaullis theorem
p2BYw=Z1P+p1BYw+H1P-Z1Q-H1Q-hf1;//meter(Pressure
    Head at Q)
disp(p1BYw,"Pressure Head at point P(m)")
disp(H1P,"Velocity Head at point P(m)")
disp(p2BYw,"Pressure Head at point Q(m)")
//Section QR
//Applying bernaullis theorem
p2dashBYw=p2BYw+H1P-H1Q-hse;//meter(Pressure Head at
    Q)
Z2=1;//meter(Datum Head)
H1Q=v2^2/2/g;//meter(velocity Head)
Z3=2;//meter(Datum Head at R)
H1R=v2^2/2/g;//meter(velocity Head at R)
//Applying bernaullis theorem
p3BYw=Z2+p2dashBYw+H1Q-Z3-H1R-hf2;//meter(Pressure
    Head at R)
disp(H1Q,"Velocity Head at point Q after enlargemant
    (m)")
disp(p2dashBYw,"Pressure Head at point Q after
    enlargemant(m)")
disp(p3BYw,"Pressure Head at point R(m)")
disp(H1R,"Velocity Head at point R(m)")
//Answer in the book is wrong for some calculations.
```

Scilab code Exa 7.12 Discharge through 300mm pipe

```
////Example 7.12
clc;
clear;
close;
format('v',6);
//Given data :
g=9.81;//gravity constanty
D1=100/1000;//meter
```

```
D2=300/1000;//meter
Q1=0.01;//m^3/sec
A1=%pi/4*D1^2;//m^2
A2=%pi/4*D2^2;//m^2
//hf1=hf2
Q2=sqrt(D2/(D1)*(Q1/A1)^2*A2^2);//cumec
disp(Q2,"Discharge throough 300mm pipe in cumec : ")
  ;
```

Scilab code Exa 7.13 Discharge in pipe line

```
////Example 7.13
clc;
clear;
close;
format('v',6);
//Given data :
g=9.81;//gravity constanty
f=0.02;//coeff. of friction
PQ=500;//meter
QR=1000;//meter
RS=500;//meter
hf=10+PQ/62.5+QR/125-RS/100-2;//meter
l=500+1000+500;///meter
D=250/1000;//meter
v=sqrt(hf*2*g*D/4/f/l);//m/s
Q=%pi/4*D^2*v;//m^3/sec
Q=Q*1000;//litres/sec
disp(Q,"Discharge in pipe line in litres/sec : ");
```

Scilab code Exa 7.14.a Diameter of pipe line

```
////Example 7.14 at page no. 250
```

```
clc;
clear;
close;
format('v',6);
//Given data :
g=9.81;//gravity constant
l=4;//km
n=5000;//habitants
Ch=200;//litres/day(habitant capacity)
t=10;//hour(daiy supply time)
hf=20;//meter(Head loss)
f=0.008;//coeff. of friction
Qty=n*Ch/2;//litres(Water supplied in 10 hours)
Q=Qty/(t*60*60);//litres/sec
Q=Q/1000;//m^3/sec
d=(f*l*1000*Q^2/3.0257/hf)^(1/5);//meter
disp(d*1000,"Diameter of pipe(mm) : ");
```

Scilab code Exa 7.14 Discharge in pipe line

```
////Example 7.14
clc;
clear;
close;
format('v',6);
//Given data :
g=9.81;//gravity constant
slope=1/125;//slope
hA=12;//meter(level of water in reservoir A)
hB=1.5;//meter(level of water in reservoir B)
L1=500;//meter
D1=250/1000;//meter
L2=1000;//meter
D2=200/1000;//meter
L3=500;//meter
```

```
D3=150/1000;//meter
f=0.02;//coeff. of friction
fall_level=(L1+L2+L3)*slope;//meter
H=hA+fall_level-hB;//meter(Head available for flow)
v2BYv1=(D1/D2)^2;
v3BYv1=(D1/D3)^2;
//H=hf=hf1+hf2+hf3
//H=(4*f*L1*v1^2/(2*g*D1)+4*f*L2*v2^2/(2*g*D2)+4*f*
    L3*v3^2/(2*g*D3))
v1=sqrt(H/(4*f*L1/(2*g*D1)+4*f*L2*v2BYv1^2/(2*g*D2)
    +4*f*L3*v3BYv1^2/(2*g*D3)));//m/s
Q=%pi*D1^2/4*v1;//m^3/sec
Q=Q*1000;//litres/sec
disp(Q,"Discharge in pipe line in litres/sec : ");
```

Scilab code Exa 7.15.a Difference in water level

```
////Example 7.15 at page no. 252
clc;
clear;
close;
format('v',6);
//Given data :
g=9.81;//gravity constant
D=30/100;//meter
l=400;//meter
Q=300;//litres/sec
f=0.008;//coeff. of friction
Q=Q*10^-3;//m^3/sec
A=%pi*D^2/4;//m^2
v=Q/A;//m/s(velocity of flow)
h1=0.5*v^2/2/g;//meter(Head loss at entrance to a
    pipe)
h2=4*f*l*v^2/(2*g*D);//meter(Head loss due to
    friction)
```

```
h3=v^2/2/g;//meter(Head loss at entrance of reservoir)
H=h1+h2+h3;//meter(Difference of water level)
disp(H,"Difference of water level between two reservoir(meter)");
//Answer in the book is not accurate as h2 is calculated wrong.
```

Scilab code Exa 7.15 Rate of flow and diameter

```
////Example 7.15
clc;
clear;
close;
format('v',6);
//Given data :
g=9.81;//gravity constant
D1=50/1000;//meter
D2=100/1000;//meter
l1=100;l2=100;//meter
hf1=10;//meter(level difference)
f=0.008;//coeff. of friction
Q2BYQ1=sqrt((l1/l2)*(D2/D1)^5);//as hf1=hf2
Q1=sqrt(hf1/f/l1*(3.0257*D1^5));//m^3/sec
Q2=Q2BYQ1*Q1;//m^3/sec or cumec
disp(Q1,"Rate of flow of pipe 1(m^3/sec)");
disp(Q2,"Rate of flow of pipe 2(m^3/sec)");
Q=Q1+Q2;//m^3/sec(Total Discharge)
d=(f*l1*Q^2/3.0257/hf1)^(1/5);//meter
disp(d*1000,"Diameter of single pipe(mm) : ");
//Answer in the book is not accurate.
```

Scilab code Exa 7.16 Discharge through pipe

```
////Example 7.16
clc;
clear;
close;
format('v',6);
//Given data :
g=9.81;//gravity constant
D=150/1000;//meter
l=70;//meter
H=2.6;//meter(head of water)
f=0.01;//coeff. of friction
//Applyong Bernoullis theorem
v=sqrt(H*(2/g*(1+0.5+4*f*l/D))/4);//m/s
Q=%pi*D^2/4*v;//m^3/sec
Q=Q*1000;//litres/sec
disp(Q,"Discharge through the pipe(litres/sec)");
```

Scilab code Exa 7.17 Velocity discharge rate and energy

```
////Example 7.17
clc;
clear;
close;
format('v',9);
//Given data :
g=9.81;//gravity constant
Cv=0.97;//coeffiecient of velocity
Cc=0.95;//coeffiecient
Dn=50/1000;//meter(Nozzle diameter)
D=100/1000;//meter(Pipe diameter)
p=6.867;//N/cm^2(Pressure at the base of nozzle)
Hb=p*10^4/(g*1000)//meter(Head at the base of nozzle)
v=Cv*sqrt(2*g*Hb);//m/s(velocty of jet)
disp(v,"Velocity in the jet(m/s)");
```

```
A=%pi/4*Dn^2;//m^2(Cross sction of jet)
Q=Cc*A*v;//m^3/sec(Discharge)
Q=Q*1000;//litres/sec
disp(Q,"Rate of discharge(litres/second)");
E=g*1000*Q/1000*Hb/1000;//kW(Energy transmitted)
disp(E,"Energy per second n the jet(kW)");
//Answer in the book is not accurate.
```

Scilab code Exa 7.18 Discharge in pipe and pressure

```
////Example 7.18
clc;
clear;
close;
format('v',9);
//Given data :
g=9.81;//gravity constant
D=100/1000;//meter(Pipe diameter)
L=700;//meter(Total length)
Lin=300;//meter(inlet length)
hf=10;//meter(Available head)
h=1.4;//meter(height)
f=0.02;//coefficient of friction
v=sqrt(hf*2*g*D/4/f/L);//m/s
Q=%pi*D^2/4*v*1000;//litres/sec
disp(Q,"Discharge in pipe(litres/second)");
//Applying Brnaullis theorem
p1=0;v1=0;Z1=0;//(Neglecting minor losses)
v2=v;//m/s
Z2=h;//meter
hf=4*f*Lin*v^2/(2*g*D);//meter
p2BYw=-v2^2/2/g-Z2-hf;//meter of water
hatm=10.3;//meter(Atmospheric pressure head)
habs=p2BYw+hatm;//meter(Absolute pressure head)
disp(habs,"Pressure at the summit of siphon(meter)")
```

;

Scilab code Exa 7.19.a Maximum Power

```
////Example 7.19 at page no. 265
clc;
clear;
close;
format('v',9);
//Given data :
g=9.81;//gravity constant
l=10000;//meter(length of pipe line)
D=0.2;//meter(Diameter of pipe)
p=60*10^5;//N/m^2
f=0.007;//coefficient of friction
w=g*1000;//N/m^3
H=p/w;//meter
hf=H/3;//meter(friction head loss is 1/3rd)
v=sqrt(hf*2*g*D/4/f/l);//m/s
P=w*%pi*D^2/4*v*(H-hf)/1000;//kW
disp(P,"Maximum power(kW)");
```

Scilab code Exa 7.19 Increase in pressure Intensity

```
////Example 7.19
clc;
clear;
close;
format('v',9);
//Given data :
g=9.81;//gravity constant
D=150/1000;//meter(Pipe diameter)
Q=40;//litres/sec(rate of discharge)
```

```
l=500;//meter(valve distance)
T=0.5;//second
v=Q/1000/(%pi/4*D^2);//m/s(velocity of flow)
pi=1000/g*(l*v/T);//kg/m^2
disp(pi,"Increase in pressure intensity(kg/m^2)");
```

Chapter 11

Flow Measurement

Scilab code Exa 11.1 Velocity of flow

```
//Example 11.1
clc;
clear;
close;
format('v',5);
//Given data :
staticPHead=5;//meter
stagnationPHead=6;//meter
h=stagnationPHead-staticPHead;//meter
g=9.81;//constant
Cv=0.98;//Coeff of pilot tube
V=Cv*sqrt(2*g*h);//m/s
disp(V,"Velocity of flow in m/sec : ");
```

Scilab code Exa 11.2 calculate Velocity

```
//Example 11.2
clc;
```

```
clear;
close;
format('v',5);
//Given data :
Cv=0.975;//Coeff of pilot tube
h=100/1000;//meter
g=9.81;//constant
Sm=13.6;//Sp. gravity
S=0.86;//gravity of turpinre
V=Cv*sqrt(2*g*h*(Sm/S-1));//m/s
disp(V,"Velocity in m/sec : ");
```

Scilab code Exa 11.3 Rate of discharge of steam

```
//Example 11.3
clc;
clear;
close;
format('v',9);
//Given data :
l=2;//meter
d0=0;//meter
d1=0.3;//meter
d2=1.0;//meter
d3=1.2;//meter
d4=1.6;//meter
d5=2.0;//meter
d6=1.4;//meter
d7=1.0;//meter
d8=0.4;//meter
d9=0.3;//meter
d10=0.2;//meter
V0=0;//meter
V1=0.5;//meter
V2=0.7;//meter
```

```
V3=0.8;//meter
V4=1.0;//meter
V5=1.2;//meter
V6=0.9;//meter
V7=0.8;//meter
V8=0.6;//meter
V9=0.5;//meter
V10=0.3;//meter
Q=1/3*(d0*V0+4*d1*V1+2*d2*V2+4*d3*V3+2*d4*V4+4*d5*V5+2*d6*V6+4*d7*V7+2*d8*V8+4*d9*V9+2*d10*V10+d0*V0);//cum/sec
disp(Q,"Rate of discharge in cum/sec : ");
```

Scilab code Exa 11.4 Find the discharge

```
//Example 11.4
clc;
clear;
close;
format('v',7);
//Given data :
Cd=0.62;//constant
H=0.12;//meter
L=0.3;//meter
g=9.81;//constant
Q=2/3*Cd*sqrt(2*g)*L*H^(3/2);//m^3/s
disp(Q,"Discharge in m^3/sec : ");
```

Scilab code Exa 11.5 Find the discharge

```
//Example 11.5
clc;
clear;
```

```
close;
format('v',8);
//Given data :
Cd=0.66;//constant
H=0.15;//meter
L=0.40;//meter
g=9.81;//constant
Q=2/3*Cd*sqrt(2*g)*L*H^(3/2);//m^3/s
disp(Q,"Discharge in m^3/sec : ");
disp(Q*10^3,"Discharge in litres/sec : ");
```

Scilab code Exa 11.6 Discharge over the notch

```
//Example 11.6
clc;
clear;
close;
format('v',6);
//Given data :
Cd=0.62;//constant
H=200/1000;//meter
theta=90;//degree
g=9.81;//constant
Q=8/15*Cd*sqrt(2*g)*tand(theta/2)*H^(5/2);//m^3/s
Q=Q*1000*60;//litres/minute
disp(Q,"Discharge in litres/minute : ");
```

Scilab code Exa 11.7 Position of apex of notch

```
//Example 11.7
clc;
clear;
close;
```

```
format('v',6);
//Given data :
Cd=0.62;//constant
Q=250;//litres/sec
Q=Q*10^-3;//m^3/s
theta=90;//degree
g=9.81;//constant
d=1.3;//meter
H=(Q/8*15/Cd/sqrt(2*g)/tand(theta/2))^(2/5);//m
h=d-H;//meter
disp(h,"Position above the bed in meter : ");
```

Scilab code Exa 11.8 calculate time taken

```
//Example 11.8
clc;
clear;
close;
format('v',6);
//Given data :
Cd=0.65;//constant
A=220;//m^2
g=9.81;//constant
l=30/100;//meter
H1=16.8/100;//meter
H2=6.8/100;//meter
T=A/[2/3*Cd*l*sqrt(2*g)]*integrate('h^(-3/2)','h',H2,H1);//sec
disp("Time taken is "+string(floor(T/60))+" minute "+string((T/60-floor(T/60))*60)+" sec.")
```

Scilab code Exa 11.9 Discharge flowing over the weir

```
//Example 11.9
clc;
clear;
close;
format('v',7);
//Given data :
H=0.40;//meter
L=5;//meter
disp("(i) End contractions are Suppressed : ");
Q=1.84*L*H^(3/2);//m^3/s
disp(Q,"Discharge in m^3/sec : ");
disp(Q*1000,"Discharge in litres/sec : ");
disp("(ii) End contractions are Considered : ");
n=2;
Q=1.84*(L-0.1*n*H)*H^(3/2);//m^3/s
disp(Q,"Discharge in m^3/sec : ");
disp(Q*1000,"Discharge in litres/sec : ");
```

Scilab code Exa 11.10 Find the discharge

```
//Example 11.10
clc;
clear;
close;
format('v',7);
//Given data :
Cd=0.62;//Coeff of discharge
H=250/1000;//meter
L=400/1000;//meter
g=9.81;//gravity acceleration
Q=2/3*Cd*sqrt(2*g)*L*H^(3/2);//m^3/s or cumec
disp(Q,"Discharge in cumec : ");
```

Scilab code Exa 11.11 Discharge over cipoletti weir

```
//Example 6.11
clc;
clear;
close;
format('v',8);
//Given data :
g=9.81;//constant
Cd=0.6;//Coefficient of discharge
B=1.3;//meter
H1=6-(1.8+1.5);//meter
H2=6-1.5;//meter
Q=2/3*Cd*B*sqrt(2*g)*(H2^(3/2)-H1^(3/2));//m^3/sec
disp(Q,"Discharge through the orifice in m^3/sec : "
    );
```

Scilab code Exa 11.12 Find the maximum discharge

```
//Example 11.12
clc;
clear;
close;
format('v',7);
//Given data :
Cd=0.60;//Coeff of discharge
L=36;//meter
H=1.1;//meter
A=50;//m^2
g=9.81;//gravity acceleration
Qmax=1.705*Cd*L*H^(3/2);//m^3/s
disp(Qmax,"Maximum Discharge in m^3/sec : ");
Va=Qmax/A;//m/s(velocity of approach)
Q=1.705*Cd*L*[(H+Va^2/2/g)^(3/2)-(Va^2/2/g)^(3/2)];
    //m^3/s
```

```
disp(Q,"New discharge considering velocity of
   approach in m^3/sec : ");
```

Scilab code Exa 11.13 Number of spillway

```
//Example 11.13
clc;
clear;
close;
format('v',7);
//Given data :
w=1.5;//m
d=0.75;//m
Cd=0.64;//Coeff of discharge
QT=45;//cumec
h=8;//meter
A=w*d;//m^2
g=9.81;//gravity acceleration
Q=Cd*A*sqrt(2*g*h);//m^3/sec
n=QT/Q;//no. of spillways
disp(round(n),"No. of spillways : ");
```

Scilab code Exa 11.14 Calculate the discharge

```
//Example 11.14
clc;
clear;
close;
format('v',6);
//Given data :
B=1;//meter
b=0.4;//meter
H=0.57;//meter
```

```
h=0.5;//meter
A=B*H;//m^2
g=9.81;//gravity constant
a=b*h;//m^2
Q=A*a/sqrt(A^2-a^2)*sqrt(2*g*(H-h));//m^3/sec
disp(Q,"Discharge in m^3/sec : ");
```