Scilab Textbook Companion for Fluid Mechanics and Turbomachines by M. M. Das[1]

Created by
P. Isaiarasan
B.E
Mechanical Engineering
BANNARI AMMAN INSTITUTE OF TECHNOLOGY, TAMILNADU
College Teacher
Dr. V. Parthiban
Cross-Checked by
Chaya Ravindra

January 30, 2015

[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: Fluid Mechanics and Turbomachines

Author: M. M. Das

Publisher: Prentice Hall, New Delhi

Edition: 1

Year: 2008

ISBN: 978-81-203-3523-3

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

Fluid Properties

Scilab code Exa 1.1 Example

```
// Finding Specific weight, Density, Specific Gravity
//Given
V=1/1000;                          //volume in m^3
w=9.6;                             //weight in Newton
g=9.81;                            //gravitational force in m/s
    ^2
//To Find
spwt=w/V;                          //Specific weoght in N/m^3
rho=spwt/g;                        //density in kg/m^3
spgr=rho/1000;                     //Specific gravity no units
disp("specific weight = "+string(spwt)+" N/m^3");
disp("density = "+string(rho)+" kg/m^3");
disp("specific gravity = "+string(spgr)+" no unit");
```

Scilab code Exa 1.3 Example

```
//Finding of Viscosity
//Given
dy=0.025*10^-3;                    //distance in meter
du=0.5;                            //velocity  in m/s
tau=1.471;                         //shear stress in N/m^2
//To Find
mu=tau*dy/du;                      //viscosity in Ns/m^2
mu1=mu*10;                         // Viscosity in poise
disp("viscosity ="+string(mu)+" in Ns/m^2");
disp("Viscosity ="+string(mu1)+" in poise")
```

Scilab code Exa 1.4 Example

```
//Finding of Diameter of water droplet
//Given
st=0.716;                          //Surface Tension in N/m
p=0.147*10^4;                      //Pressure in N/m^2
//To Find
d=4*st/p;                          //Dia in meter
d1=d*10^2;                         //Dia in centimeter
d2=d*10^3;                         // Dia in millimeter
disp("Diameter ="+string(d)+" meter");
disp("Diameter ="+string(d1)+" Centi meter");
disp("Diameter ="+string(d2)+" Milli meter");
```

Scilab code Exa 1.5 Example

```
//Finding of Shear Stress
//Given
```

```
3 //du/dy = vg
4 vg=.25;                //Velocity gradient in m/sec/
     meter
5 nu=6.30*10^-4;          //Kinematic viscosity in m^2/
     sec
6 rho=1268.4;              //Mass density in Kg/m^3
7 mu=rho*nu;               //Dynamic Viscosity
8 //To Find
9 tau=mu*vg;             //Shear stress in N/m^2
10 disp("Shear Stress ="+string(tau)+" N/m^2");
```

Scilab code Exa 1.6 Example

```
1 //Finding of increase of Pressure
2 //Given
3 k=2.07*10^6;              // Bulk Modulus in KN/m^2
4 dv=0.01;                 //Change in Volume
5 //To Find
6 p=k*(dv);               // Change in pressure
7 disp(" Increase in Pressure ="+string(p)+" KN/m^2");
```

Scilab code Exa 1.7 Example

```
1 //Finding of Cappilary rise
2 //Given
3 d=0.03*10^-2;                  //Diameter in meter
```

```
4 st=0.0735;                    //Surface Tension in N/
    m
5 x=0;                         //contact angle in degree
6 w=1000*9.81;
7 //To Find
8 h=(4*st)*cos(x)/(w*d);
9 h1=h*10^2;
10 disp(h);
11 disp("Capillary rise ="+string(h)+" meter");
12 disp("Capillary rise ="+string(h1)+" Centi meter");
```

Scilab code Exa 1.8 Example

```
1 //Finding of Kinematic Viscosity
2 //Given
3 tau=0.2158;                   //Shear stress in N/m^2
4 vg=0.218;                    //Velocity Gradient in sec
    ^-1
5 rho=959.5;                    //Density in Kg/m^3;
6 //To Find
7 mu=tau*1/vg;
8 disp("Dynamic Viscosity ="+string(mu)+" Ns/m^2");
9 nu=mu/rho;
10 disp("Kinematic Viscosity ="+string(nu)+" m^2/sec");
11 nu1=nu*10^4;
12 disp(" Knematic Viscosity ="+string(nu1)+" cm^2/sec"
    );
13 nu2=nu1*10^-4;
14 disp("Kinematic Viscosity ="+string(nu2)+" strokes")
    ;
```

Chapter 2

Fluid Pressure and its measurement

Scilab code Exa 2.1 Example

```
1 //Finding of Pressure Intensity
2 //Given
3 p=73.575*10^4;        //Pressure in N/mm^2
4 Patm=76;
5 rho=1000;              //Density in kg/m^3
6 spgr=13.6;
7 g=9.81;                //Gravitational force in m/s
    ^2
8 //To Find
9 //Gauge units
10 P1=p/(rho*g);
11 P2=p/(spgr*rho*g);
12 //Absolute units
13 P3=(Patm*spgr)/100;
14 P4=(Patm*spgr*rho*g)/100;
15 P5=P2/10000;
16 P6=p+P5;
17 P7=75+P5;
18 P8=5.5147+(Patm/100);
```

```
19 disp("Gauge Units ");
20 disp("Pressure ="+string(P1)+" meter of water");
21 disp("Pressure ="+string(P2)+" meter of mercury");
22 disp("Pressure ="+string(P3)+" meter of water");
23 disp("Pressure ="+string(P5)+" N/cm^2");
24 disp("Pressure ="+string(P7)+" meter of water");
25 disp("Pressure ="+string(P8)+" meter of Mercury");
```

Scilab code Exa 2.2 Example

```
1 //Finding of Depth of Water
2 //Given
3 p=100.5525*10^4;                    //pressure intensity
      in N/m^2
4 spgr=1.025;                         //Specific gravity
5 rho=1000;                           //Density of water in kg/
     m^3
6 g=9.81;                             //Gravitational force due
      to acceleration in m/sec^2
7 w=rho*g;
8 //To Find
9 h=p/w;
10 disp("Depth of Water = "+string(h)+" m");
```

Scilab code Exa 2.3 Example

```
1 //Finding of Height
```

```
2 //Given
3 p=4.9*10^4;                //Pressure intensity in N/mm^2
4 rho=1000;                  //Density of water in kg/m^3
5 g=9.81;                    //gravitational force in m/sec
    ^2
6 spgr=0.8;                  //Specific gravity of oil
7 w=rho*g;
8 w1=rho*g*spgr;
9 //To Find
10 h=p/w;
11 h1=p/w1;
12 disp("Height of water ="+string(h)+" m");
13 disp("Height of oil ="+string(h1)+" m");
```

Scilab code Exa 2.4 Example

```
1 //Finding of Pressure intensity
2 //Given
3 spgr=0.8;                    //Specific gravity of oil
4 spgr1=1.5;
5 rho=1000;                    //Density of water in Kg/m^3
6 g=9.81;                      //Gravitational force m/s^2
7 h1=2;                         //Depth in meter
8 //To Find
9 w=rho*g*spgr;
10 p=w*h1;                      //Pressure at the interface
11 disp("Pressure Intensity ="+string(p)+" N/m^2");
12 w1=rho*g*spgr1;
13 p1=1.5969+w1;
14 disp("Pressure Intensity at Bottom ="+string(p1)+" N
    /m^2");
```

Scilab code Exa 2.5 Example

```
1 //Finding of Pressure
2 //Given
3 spgr1=0.8;                  //specific gravity of liquid
4 spgr2=13.6;                 //specific gravity of
     mercury
5 h1=0.6;                     //height in left limb in
     meter
6 h2=0.15;                    //height in right limb in
     meter
7 g=9.81;                     //gravitaional force in m/s
     ^2
8 rho1=spgr1*1000;            //density of liquid in Kg/m
     ^3
9 rho2=spgr2*1000;            //density of mecury  in Kg/m
     ^3
10 p=10.13;
11 //To Find
12 p1=(rho2*g*h2)-(rho1*g*h1);
13 disp("Pressure at A ="+string(p1)+" N/m^2");
14 p2=p1/100+p;
15 disp("Absolute Pressure "+string(p2)+" N/cm^2")
```

Scilab code Exa 2.6 Example

```
//Finding of Pressure difference
//Given
P1=10.8*10^4;          //Pressure in N/mm^2
P2=17.16*10^4;
rho=1000;               //Density in kg/m^3
g=9.81;                //Gravitational force in m/s^2
spgr1=1.594;
spgr2=13.6;
spgr3=0.8;
z1=4;                   //height in meter
//To Find
left=P1+((spgr1*rho*g)*z1)+(spgr2*rho*g);
right=((spgr3*rho*g)*1.5)+P2;
h=left/(12*right);
h1=h*100;
disp("Height ="+string(h)+" meter of mercury");
disp("Height ="+string(h1)+" centimeter of mercury")
   ;
```

Scilab code Exa 2.7 Example

```
//Finding of Pressure
//Given
//Left Limb
h=0.6;
rho=1000;
g=9.81;
//Right Limb
h1=0.45;
spgr1=13.6;
h2=0.30;
spgr2=0.88;
//To Find
P=(h1*spgr1)+(h2*spgr2)-(h);
disp("Pressure is ="+string(P)+" cm of water");
```

```
15 p1=P*rho*g;
16 disp("Pressure is = "+string(p1)+" N/m^2");
```

Scilab code Exa 2.8 Example

```
1 //Finding of Elevation
2 //Given
3 //At Sea level
4 p=760;     //pressure in mm of mercury
5 rho=1000; //Density in kg/m^3
6 spgr=13.6;
7 g=9.81; //gravitational force in m/sec^2
8 p1=(p/1000)*rho*g*spgr;
9 //At Mountain
10 p2=735;
11 p3=(p2/1000)*rho*g*spgr;
12 rho1=1.2;
13 //To Find
14 h=(p1-p3)/(rho1*g);
15 disp("Elevation is ="+string(h)+" meter");
```

Scilab code Exa 2.9 Example

```
1 //Finding of Pressure and Temperature
2 //Given
3 h=18.288;     //Height in  kilometer
4 t0=288.15;
```

```
5  l=6.5;          // Lengh in meter
6  p0=101.18;     //Pressure in N/mm^2
7  g=9.81;           //gravitational force in m/s^2
8  //To Find
9  T=t0-(l*h);
10 disp("Temperature is ="+string(T)+" kelvin");
11 Ps=p0*(1-(l*h/t0))^(g/(287.1*l));
12 disp("Pressure is = "+string(Ps)+" KN/m^2");
```

Chapter 3

Hydrostatic Forces on surfaces

Scilab code Exa 3.2 Example

```
1 //Finding of Total Pressure
2 //Given
3 d=1.5;
4 y1=2;
5 rho=1000;
6 g=9.81;
7 //To Find
8 Ig=(%pi*d^4)/64;
9 Ay=(%pi/4)*d^2;
10 P=Ay*rho*g*y1;
11 Ycp=(Ig/Ay)+y1;
12 disp("P= "+string(P)+" Newtons");
13 disp("Ycp ="+string(Ycp)+" meter");
```

Scilab code Exa 3.3 Example

```
//Finding of Totoal Pressure , Depth of centre
//given
d=2.5;
rho=1000;
g=9.81;
y1=2;
//To Find
Ig=(%pi*d^4)/64;
Ay=(%pi/4)*d^2;
P=Ay*rho*g*y1;
a=4/6.25;
Ycp=((Ig*a)/(Ay*y1))+y1;
disp("P= "+string(P)+" Newtons");
disp("Ycp ="+string(Ycp)+" meter");
```

Scilab code Exa 3.4 Example

```
//Finding of Total Pressure , Depth of pressure
//Given
b=5;
h=5;
spgr=0.8;
rho=800;
g=9.81;
y1=(1+(5/3));
//To Find
Ig=(b*h^3)/36;
Ay=(1/2)*b*h;
P=Ay*rho*g*y1;
Ycp=(Ig/(Ay*y1))+y1;
disp("P= "+string(P)+" Newtons");
disp("Ycp ="+string(Ycp)+" meter");
```

Scilab code Exa 3.5 Example

```
1 //Finding of Total Pressure , Depth of pressure
2 //Given
3 T=4;
4 rho=1000;
5 g=9.81;
6 l=2;
7 b=1/2;
8 y1=2;
9 y2=1/3;
10 //To Find
11 A=(6/2)*1;
12 A1=(l*b);
13 A2=l*5;
14 y3=((A1*y1)+(2*A2*y2))/(A1+2*A2);
15 P=rho*g*A*y3;disp(y3);
16 Ig=(l^2+(4*l*T)+T^2)/(36*(l+T));
17 Ycp=(Ig/(A*y3))+y3;
18 disp("P= "+string(P)+" Newtons");
19 disp("Ycp ="+string(Ycp)+" meter");
```

Scilab code Exa 3.6 Example

```
1 //Finding of Total Pressure , Depth of pressure
2 //Given
3 spgr=0.9;
4 rho=900;
```

```
rho1=1000;
spgr1=0.6;
g=9.81;
y1=spgr*(2/3);
y2=spgr+(spgr1/2);
y3=spgr+((spgr1/3)*2);
//To Find
P1=rho*g*spgr;
P2=P1+(rho1*spgr1*g);
P=(0.5*P1*spgr*1.5)+(((P1+P2)/2)*spgr1*1.5);
disp("P ="+string(P)+" Newton");
P3=P2-P1;
Ycp=((P1*y1)+(P2*y2)+(P3*y3))/P;
disp("Ycp ="+string(Ycp)+" meter");
```

Scilab code Exa 3.7 Example

```
//Finding of Total Pressure
//Given
BC=2;
d=2;
y1=2.5;
rho=1000;
g=9.81;
//To Find
Ig=(1*BC^3)/2;
Ay=((1*BC^3)/2)*y1;
Px=Ay*rho*g/2;
Ycp=(Ig/Ay)+y1;
Py=((2*1.5)*(%pi/4)*d^2)*rho*g;
disp("Px= "+string(Px)+" Newtons");
disp("Ycp ="+string(Ycp)+" meter");
disp("Py= "+string(Py)+" Newtons");
```

Chapter 4

Buoyancy and Floatation

Scilab code Exa 4.1 Example

```
1 //Finding of water displaced and position of centre
     buoyancy
2 //Given
3 l=2;
4 h=1.5;
5 b=4;
6 v=l*b*h;
7 spgr=0.7;
8 rho=700;
9 rho1=1000;
10 g=9.81;
11 w=rho*g*v;
12 //To Find
13 wd=w/(rho1*g);
14 disp("Water Displaced = "+string(wd)+" m^3");
15 h1=wd/(l*b);
16 h2=h1/2;
17 disp("Positin of Centre Buoyancy = "+string(h2)+" m"
     );
```

Scilab code Exa 4.3 Example

```
1 //Finding of volume and specific gravity
2 //given
3 w=490.5;                  //In Air in Newton
4 w1=196.2;                 //In Water in Newton
5 rho=1000;
6 g=9.81;
7 rho1=5000;
8 //To Find
9 wd=w-w1;
10 vd=wd/(rho*g);
11 rho2=(w/g)/vd;
12 spgr=rho1/(rho*3);
13 disp("Volume = "+string(rho2)+" Kg/m^3");
14 disp("Specific Gravity  is= "+string(spgr)+" No
    units")
```

Scilab code Exa 4.4 Example

```
1 //Finding of Mass,Density,Specific Gravity
2 //Given
3 v=2*1*3;
4 w=3924;
5 rho=1000;
6 g=9.81;
7 wd=rho*g*v;
8 w1=w+wd;
```

```
m=w1/g;
rho1=m/v;
spgr=rho1/rho;
disp("Mass is = "+string(m)+" Kg");
disp("Density is = "+string(rho1)+" Kg/m^3");
disp("Specific Gravity = "+string(spgr)+" No units")
```

Scilab code Exa 4.5 Example

```
//Finding of Density
//Given
h1=0.4;
h2=0.6;
rho=1000;
rho1=13600;
g=9.81;
wd=rho*0.6;
md=rho1*0.4;
rho2=wd+md;
disp("Density is = "+string(rho2)+" Kg/m^3");
```

Scilab code Exa 4.6 Example

```
//Finding of  Weight and Metacentric height
//Given
l=4;
b=2;
```

```
h=1;
d=0.6;
v=l*b*d;
rho=1000;
g=9.81;
//To Find
wd=rho*g*v;
disp("Weight of the body ="+string(wd)+" Newtons");
I=(l*b^3)/12;
h1=h/2;
d1=d/2;
h2=h1-d1;
mh=(I/v)-h2;
disp("Metacentric Height ="+string(mh)+" meter");
```

Scilab code Exa 4.7 Example

```
//Finding pf Metacentric Height
//Given
d=3;
h=2;
spgr=0.7;
h1=h*spgr;
pi=3.14;
//To Find
h2=h/2;
h3=h1/2;
h4=h2-h3;
mh=(pi*d^4)/64;
vwd=(pi*d^2*h1)/4;
mg=(mh/vwd)-h4;
disp("Metacentric Height is ="+string(mg)+" meter");
```

Chapter 5

Kinematics of Fluid Flow

Scilab code Exa 5.1 Example

```
1  //Finding of velocity and discharge
2  //Given
3  d1=0.4;
4  r1=d1/2;
5  d2=0.2;
6  r2=d2/2;
7  v1=5;
8  pi=3.14;
9  //To Find
10 a1=(pi*r1^2);
11 a2=(pi*r2^2);
12 v2=(a1*v1)/a2;
13 q2=a2*v2;
14 disp("Velocity at section -2 ="+string(v2)+" m/
       second");
15 disp("Discharge ="+string(q2)+"m^3/seconds");
```

Scilab code Exa 5.2 Example

```
1 //Finding of Discharge and velocity
2 //Given
3 d1=0.4;
4 d2=0.3;
5 d3=0.2;
6 pi=3.14;
7 //To Find
8 q1=(pi/4)*d1^2*3;
9 q2=(pi/4)*d2^2*2;
10 q3=q1-q2;
11 v3=q3/((pi/4)*d3^2);
12 disp("Discharge at section- 1="+string(q1)+" m^3/sec
   ");
13 disp("Discharge at section- 2="+string(q2)+" m^3/sec
   ");
14 disp("Discharge at section- 3="+string(q3)+" m^3/sec
   ");
15 disp("velocity at section- 3 ="+string(v3)+" m/sec")
   ;
```

Scilab code Exa 5.10 Example

```
1 //Finding of convective acceleration
2 //Given
3 v1=2.5;
4 v2=16;
```

```
5  s=3.75;
6  //To Find
7  a=(v2-v1)/s;
8  a1=v1*a;
9  a2=v2*a;
10 disp("Acceleration at inlet="+string(a1)+" m/s^2");
11 disp("Acceleration at outlet="+string(a2)+" m/s^2");
```

Chapter 6

Dynamics of Fluid Flow

Scilab code Exa 6.3 Example

```
1  //Finding of Discharge
2  //Given
3  d1=30;
4  d2=15;
5  hom=10;
6  cod=0.98;
7  pi=3.14;
8  g=9.81;
9  //To Find
10 a1=(pi/4)*d1^2;
11 a2=(pi/4)*d2^2;
12 h=hom*(12.6);
13 q=(cod*a1*a2*(2*100*g*h)^(1/2))/((a1^2-a2^2)^(1/2));
14 q1=q/1000;
15 disp("Discharge ="+string(q1)+" m^3/sec");
```

Scilab code Exa 6.4 Example

```
1 //Finding of Discharge
2 //Given
3 d1=30;
4 d2=15;
5 hom=30;
6 cod=0.98;
7 g=9.81;
8 pi=3.14;
9 //To Find
10 a1=(pi/4)*d1^2;
11 a2=(pi/4)*d2^2;
12 h=hom*(12.6);
13 q=(cod*a1*a2*(2*100*g*h)^(1/2))/((a1^2-a2^2)^(1/2));
14 q1=q/1000;
15 disp("Discharge ="+string(q1)+" m^3/sec");
```

Scilab code Exa 6.5 Example

```
1 //Finding of Rate of flow
2 //Given
3 d1=30;
4 d2=15;
5 hom=30;
6 cod=0.98;
7 g=9.81;
8 pi=3.14;
```

```
//To Find
a1=(pi/4)*d1^2;
a2=(pi/4)*d2^2;
h=hom*((13.6/0.8)-1);
q=(cod*a1*a2*(2*100*g*h)^(1/2))/((a1^2-a2^2)^(1/2));
q1=q/1000;
disp("Discharge ="+string(q1)+" m^3/sec");
```

Scilab code Exa 6.6 Example

```
//Finding of Pressure Difference
//Given
g=9.81;
spgr=0.9;
spgr1=13.6;
rho=1000;
rho1=spgr*1000*g;
zd=0.3;
gd=25;
x=(spgr1/spgr)-1;
x1=((gd*x)/100)+zd;
//To find
pd=x1*rho1;disp(x1);
disp("Pressure Difference ="+string(pd)+" N/m^2");
pd1=pd/10000;
disp("Pressure Difference ="+string(pd1)+" N/cm^2");
```

Scilab code Exa 6.7 Example

```
//Finding of Rate Of Flow
//Given
d1=15;
d2=30;
hm=50;
spgr=0.9;
spgr1=13.6;
cod=0.64;
g=9.81;
//To Find
A0=(%pi/4)*d1^2;
A1=(%pi/4)*d2^2;
h=((spgr1/spgr)-1)*hm;
x=(A0*A1)/sqrt(A1^2-A0^2);
y=sqrt(2*g*h);
q=cod*x*y;
disp(" Discharge ="+string(q)+" cm^3/sec");
q1=q/100;
disp(" Discharge ="+string(q1)+" ltr/sec");
```

Scilab code Exa 6.8 Example

```
//Fiding of Discharge
//Given
d1=0.3;
pd=0.06;
g=9.81;
cv=0.98;
//To Find
vc=sqrt(2*g*pd)*cv;
V=0.8*vc;
A=(%pi/4)*d1^2;
q=V*A;
```

```
12 disp(" Discharge ="+string(q)+" m^3/sec");
```

Chapter 7

Flow Through Pipes

Scilab code Exa 7.1 Example

```
1  //Finding of Loss of Head
2  //Given
3  q1=200;
4  d1=150;
5  d2=300;
6  g=9.81;
7  //To Find
8  v1=200*(4/%pi)*(100/150)^2;
9  disp(v1);
10 v2=200*(4/%pi)*(100/300)^2;
11 disp(v2);
12 h=((v1-v2)^2)/20*g;
13 h1=h/1000;
14 disp(" Loss of Head ="+string(h1)+" meter of water")
   ;
```

Scilab code Exa 7.3 Example

```
1 //Finding of Discharge
2 //Given
3 d=0.3;
4 l=400;
5 f=0.00225;
6 h=5;
7 g=9.81;
8 //To Find
9 x=(h*2*g*d)/(f*l);
10 v=sqrt(x);
11 disp(v);
12 A=(%pi/4)*d^2;
13 q=A*v;disp(A);
14 disp(" Discharge ="+string(q)+" m^3/sec");
```

Scilab code Exa 7.6 Example

```
1 //Finding of Head
2 //Giiven
3 f=0.032;
4 l=400;
5 d=0.3;
6 q=0.3;
7 g=9.81;
8 //TO find
9 A=(%pi/4)*d^2
```

```
10 V=q/A;
11 v1=(V^2);
12 x=1.5+(f*l/d);
13 y=v1/(2*g);
14 H=x*y;
15 disp("Difference in water level ="+string(H)+" meter
     ")
```

Scilab code Exa 7.9 Example

```
1 //Finding of Equivalent Diameter
2 //Given
3 L=1400;
4 L1=800;
5 L2=400;
6 L3=200;
7 D1=0.6;
8 D2=0.4;
9 D3=0.2;
10 //To Find
11 a=L1/(D1)^5;disp(a);
12 b=L2/(D2)^5;disp(b);
13 c=L3/(D3)^5;disp(c);
14 d=(a+b+c);disp(d);
15 d1=d^1/5;
16 D=L/d1;
17 disp( "Diameter ="+string(D)+" meter");
```

Scilab code Exa 7.12 Example

```
1  //Finding of Maximum Power Outlet
2  //Given
3  d=0.4;
4  l=400;
5  H=420;
6  rho=1000;
7  f=0.025;
8  g=9.81;
9  pi=3.14;
10 //To Find
11 h=H/3;
12 h1=(f*l*100)/(2*g*d);
13 v=sqrt(h/h1);disp(h); disp(h1);
14 a=(pi/4)*d^2;
15 q=a*v;
16 h3=H-h;disp(h3);
17 p=(rho*g*q*h3)/1000;
18 disp(" Maximum Power Outlet ="+string(p)+" KW");
```

Scilab code Exa 7.13 Example

```
1  //Finding of Rise of Pressure
2  //Given
3  l=2000;
4  d=0.6;
5  v=2;
6  c=1420;
7  t=20;
8  rho=1000;
9  //To Find
10 p=(rho*l*v)/t
11 p1=p/10000;
12 disp("Rise of Pressure ="+string(p1)+"N/cm^2");
```

Scilab code Exa 7.14 Example

```
1 //Finding of Rise of Pressure
2 //Given
3 l=2000;
4 d=0.6;
5 v=2;
6 t=20;
7 k=19.62*10^8;
8 rho=1000;
9 //To Find
10 c=sqrt(k/rho);
11 p=rho*v*c
12 p1=p/10000;
13 disp("Rise of Pressure ="+string(p1)+"N/cm^2");
```

Scilab code Exa 7.15 Example

```
1 //Finding of Rise of Pressure and circumferential,
    Longitudinal stress
2 //Given
3 l=2000;
4 d=0.6;
5 v=2;
6 t=0.01;
7 k=19.62*10^8;
8 rho=1000;
```

```
E=19.62*10^10;
//To Find
a=(1/k)+(d/(t*E));
b=(1/rho)*a;
c=sqrt(b);
p=2/c;
p1=p/10000;
fc=((p*d)/(2*t))/10000;
fl=((p*d)/(4*t))/10000;
disp("Rise of Pressure ="+string(p1)+"N/cm^2");
disp("Circumferential stress ="+string(fc)+" N/m^2")
    ;
disp("Longitudinal stress ="+string(fl)+" N/m^2");
```

Scilab code Exa 7.16 Example

```
//Finding of Maximum rise of water level,velocity,
   Time of occurance
//Given
d=4;
d1=1;
l=150;
q=2;
g=9.81;
//To Find
a1=(%pi/4)*d^2;
a2=(%pi/4)*d1^2;
v=q/a2;
a=(l*a2)/(g*a1);
b=sqrt(a);
h=v*b;
c=(l*a1)/(g*a2);
d=sqrt(c);
```

```
17 t=(%pi/2)*d;
18 v1=v*(a2/a1);
19 disp("Maximum rise of water ="+string(h)+" meter");
20 disp("Time taken ="+string(t)+" seconds");
21 disp("Maximum Velocity ="+string(v1)+" m/sec");
```

Chapter 8

Flow Through Orifices and Mouthpieces

Scilab code Exa 8.1 Example

```
1  //Finding of Actual Discharge, velocity
2  //Given
3  d=0.05;
4  H=12;
5  Cd=0.6;
6  Cv=0.98;
7  g=9.81;
8  //To Find
9  a=(%pi/4)*d^2;
10 v=sqrt(2*g*H);
11 q=Cd*a*v;
12 V=Cv*v;
13 disp("Actual Discharge ="+string(q)+" m^3/sec");
14 disp("Actual Velocity ="+string(V)+" m/sec");
```

Scilab code Exa 8.2 Example

```
1 //Finding of Coefficient of Discharge
2 //Given
3 d=0.03;
4 H=1.5;
5 Ad=2.35*10^-3;
6 g=9.81;
7 //To Find
8 a=(%pi/4)*d^2;
9 b=sqrt(2*g*H);
10 Td=b*a;
11 Cd=Ad/Td;
12 disp(" Coefficient of Discharge ="+string(Cd)+" No
    units");
```

Scilab code Exa 8.3 Example

```
1 //Finding of Cv,Cc
2 //Given
3 H=0.6;
4 x=0.1;
5 y=0.0045;
6 Cd=0.6;
7 //To Find
8 a=sqrt(4*y*H);
9 Cv=x/a;
10 Cc=Cd/Cv;
```

```
11 disp("Cv ="+string(Cv)+" No units");
12 disp("Cc ="+string(Cc)+" No units");
```

Scilab code Exa 8.4 Example

```
1  //Finding of Cv,Cd,Cc
2  //Given
3  H=5;
4  d1=0.1;
5  d2=2;
6  t=30;
7  h=0.45;
8  x=1;
9  g=9.81;
10 y=0.052;
11 H=5;
12 //To Find
13 A1=(%pi/4)*d2^2;
14 Aq=(A1*h)/t;
15 A2=(%pi/4)*d1^2;
16 b=sqrt(2*g*H);
17 Tq=A2*b;
18 Cd=Aq/Tq;
19 c=sqrt(4*y*H);
20 Cv=x/c;
21 Cc=Cd/Cv;
22 disp(" Cd ="+string(Cd)+" No units");
23 disp(" Cv ="+string(Cv)+" No units");
24 disp(" Cc ="+string(Cc)+" No units");
```

Scilab code Exa 8.6 Example

```
1 //Finding of Dischage through Rectangular orifice
2 //Given
3 H1=4;
4 H2=6;
5 Cd=0.62;
6 g=9.81;
7 //To Find
8 a=H2^(3/2)-H1^(3/2);
9 b=sqrt(2*g);
10 q=Cd*2*b*a;
11 disp("Dischage through Rectangular orifice ="+string
   (q)+" m^3/sec");
```

Scilab code Exa 8.7 Example

```
1 //Finding of Dischage through a fully submersed
   Orifice
2 //Given
3 b=2;
4 H=0.8;
5 H1=2.5;
6 H2=3;
7 Cd=0.6;
8 g=9.81;
9 //To Find
10 a=sqrt(2*g*H);
```

```
11 q=Cd*a*b*(H2-H1);
12 disp("Dischage through a fully submersed Orifice ="+
      string(q)+" m^3/sec");
```

Scilab code Exa 8.8 Example

```
1 //Dischage through Orifice
2 //Given
3 b=1.5;
4 H1=3.2;
5 H2=2;
6 H3=2.4;
7 Cd=0.62;
8 g=9.81;
9 //To Find
10 a=H3^(3/2)-H2^(3/2);
11 q1=(2/3)*Cd*b*sqrt(2*g)*a;
12 q2=Cd*b*(H1-H3)*sqrt(2*g*H3);
13 q3=q1+q2;
14 disp("Dischage through Orifice ="+string(q3)+" m^3/
      sec");
```

Scilab code Exa 8.9 Example

```
1 //Finding of Time Taken
2 //Given
3 d1=3;
4 d2=0.4;
5 H1=4;
```

```
H2=2;
g=9.81;
Cd=0.6;
//To Find
A=(%pi/4)*d1^2;
a=(%pi/4)*d2^2;
//To empty from 4-2 meter
c=sqrt(H1)-sqrt(H2);
T=(2*A*c)/(Cd*a*sqrt(2*g));
disp("Time Taken To empty from 4 to 2 meter ="+
   string(T)+" seconds");
//To empty the tank fully
T1=(2*A*sqrt(H1))/(Cd*a*sqrt(2*g));
disp("Time Taken To empty the tank ="+string(T1)+"
   seconds");
```

Chapter 9

Flow over Notches and weirs

Scilab code Exa 9.1 Example

```
1 //Finding of Discharge through rectangular Notch
2 //Given
3 H=0.4;
4 L=3;
5 Cd=0.6;
6 g=9.81;
7 //To Find
8 q=(2/3)*Cd*L*sqrt(2*g)*H^(3/2);
9 disp("Discharge through rectangular Notch ="+string(
    q)+" m^3/sec");
```

Scilab code Exa 9.2 Example

```
1 //Finding of Height
2 //Given
```

```
3 q=1.5;
4 Cd=0.6;
5 L=5;
6 g=9.81;
7 //To Find
8 H=q/((2/3)*Cd*L*sqrt(2*g));
9 H1=H^(2/3);
10 Z=q-H1;disp(H1);
11 disp("Height ="+string(Z)+" meter");
```

Scilab code Exa 9.3 Example

```
1 //Finding of Position of Apex of Notch
2 //Given
3 q=0.20;
4 d=1;
5 theta=90;
6 Cd=0.62;
7 g=9.81;
8 //To Find
9 b=(theta/2);
10 H=q/((8/15)*Cd*sqrt(2*g)*tan(b));
11 H1=H^(2/5);
12 p=d-H1;
13 disp("Position of Apex of Notch ="+string(p)+" meter
   ");
```

Scilab code Exa 9.4 Example

```
1 //Finding of discharge through Trapezoidal Notch
2 //Given
3 H=0.3;
4 Cd1=0.62;
5 Cd2=0.6;
6 d=0.4;
7 w1=1.2;
8 w2=0.5;
9 h=0.4;
10 g=9.81;
11 //To Find
12 theta=((w1-w2)/2)/h;disp(theta);
13 q1=((2/3)*Cd1*sqrt(2*g)*H^(3/2));
14 q2=((8/15)*Cd2*sqrt(2*g)*theta*H^(5/2));
15 q=q1+q2;disp(q1);disp(q2);
16 disp("discharge through Trapezoidal Notch ="+string(
   q)+" m^3/sec");
```

Scilab code Exa 9.5 Example

```
1 //Finding of Percentage Error in Discharge
2 //Given
3 Cd=0.6;
4 q=40000;
5 L=0.5;
6 H=0.2;
7 g=9.81;
8 //To Find
9 H1=q/((2/3)*Cd*L*sqrt(2*g));
10 H2=H1^(2/3);
11 H3=H2/100;
12 dq=(3/2)*(H/H3)*100;
13 disp("Percentage Error in Discharge ="+string(dq)+"
```

```
Percentage");
```

Scilab code Exa 9.8 Example

```
//Finding of Discharge over a Cipolletti weir
//Given
L=1.8;
H=1.2;
Cd=0.632;
//To Find
q=1.866*L*H^(3/2);
disp("Discharge over a Cipolletti weir ="+string(q)+
   " m^3/sec");
```

Scilab code Exa 9.9 Example

```
//Finding of Dischage
//Given
Cd1=0.6;
Cd2=0.8;
L=3.5;
g=9.81;
H1=0.3;
H2=0.15;
//To Find
q1=((2/3)*Cd1*L*sqrt(2*g)*(H1-H2)^(3/2));
q2=Cd2*L*H2*sqrt(2*g*(H1-H2));
q3=q1+q2;
disp("Dischage ="+string(q3)+" m^3/sec");
```

Scilab code Exa 9.10 Example

```
1 //Finding of Discharge
2 //Given
3 L=5.4;
4 n=6;
5 H=0.45;
6 //To Find
7 q=1.84*(L-(0.1*n*H))*H^(3/2);
8 disp("Discharge ="+string(q)+" m^3/sec");
```

Chapter 10

Open Channel Flow

Scilab code Exa 10.1 Example

```
1 //Finding of velocity of flow and discharge
2 //Given
3 c=50;
4 sb=1/3000;
5 R=10/9;
6 a=10;
7 //To Find
8 b=R*sb;
9 v=c*sqrt(b);
10 q=a*v;
11 disp("Velocity of flow ="+string(v)+" m/sec");
12 disp("Discharge ="+string(q)+" m^3/sec");
```

Scilab code Exa 10.2 Example

```
1  //Finding of bed slope and conveyance of channel
2  //Given
3  q=0.15;
4  B=.70;
5  y=.40;
6  C=60;
7  A=B*y;
8  P=B+(2*y);
9  R=(A/P);
10 //To Find
11 sb=((q^2)*(P))/((A^3)*C^2)
12 K=A*C*sqrt(R);
13 disp("Bed of slope ="+string(sb)+" no units");
14 disp("conveyance of channel ="+string(K)+" m^3/sec")
      ;
```

Scilab code Exa 10.3 Example

```
1  //Finding of discharge through trapezoidal channel
2  //Given
3  B=6;
4  z=1/3;
5  C=60;
6  y=3;
7  sb=1/5000;
8  //To Find
9  A=(B+z*y)*y;
10 P=B+(2*y*sqrt(1+z^2));
11 R=A/P;
12 q=A*C*sqrt(R*sb);
13 disp("Discharge through Trapezoidal channel ="+
      string(q)+" m^3/sec");
```

Scilab code Exa 10.4 Example

```
1 //Finding of Bottom slope, Conveyance
2 //Given
3 q=0.1;
4 B=0.6;
5 y=0.3;
6 A=B*y;
7 n=0.013;
8 P=1.2;
9 R=A/P;
10 //To Find
11 b=((q^2)*(P))/((A^3)*B^2)
12 K=A*B*sqrt(R);
13 disp("Bed of slope ="+string(b)+" no units");
14 disp("conveyance of channel ="+string(K)+" m^3/sec")
   ;
```

Scilab code Exa 10.5 Example

```
1 //Finding of Bed slope of Trapezoidal channel
2 //Given
3 B=6;
4 y=3;
5 z=3/4;
6 q=30;
7 A=(B+(z*y))*y;
8 P=B+(2*y)*sqrt(1+z^2);
```

```
R=(A/P);
n=0.0158;
//To Find
sb=((q^2)*n^2)/((A^2)*(R^(4/3)));
disp("Bed slope of Trapezoidal channel ="+string(sb)
   +" no units");
```

Scilab code Exa 10.6 Example

```
//Finding of discharge through triangular channel
//Given
y=4;
theta=60;
b=theta/2;
n=0.0182;
sb=1/1000;
T=2*tan(b)*y;z=tan(b); disp(z);
A=0.5*T*y;
P=2*sqrt(y^2+(y*tan(b))^2);
R=A/P;disp(A);disp(P);disp(R);
//To Find
q=A*(1/n)*(R)^2/3*(sb)^1/2;
disp("discharge through triangular channel ="+string
   (q)+" m^3/sec");
```

Scilab code Exa 10.7 Example

```
//Finding of Diameter of circular channel
//Given
```

```
3 q=1;
4 n=0.02;
5 sb=1/10000;
6 //To Find
7 q=((%pi/8)*(1/n)*(1/sb)^(1/2)*(1/4)^(2/3));
8 D=(8/%pi)*n*(1/sb)^(-0.5)*(4)^(2/3);
9 D1=(D)^(3/8);
10 disp("Diameter of Circular Pipe ="+string(D)+" meter
    ");
```

Scilab code Exa 10.8 Example

```
1 //Finding of Dimemsions
2 //Given
3 q=0.5;
4 sb=1/3000;
5 c=60;
6 n=0.015;
7 //To Find
8 y=q/(2*c*(1/2)^(0.5)*(sb)^(1/2));
9 y1=y^(2/5);
10 b=2*y1;
11 y2=q/(2*(1/n)*(1/2)^(2/3)*(sb)^(1/2));
12 y3=(y2)^(3/8);
13 b1=2*y3;
14 disp("Economical Dimensions ="+string(b)+" meter");
15 disp("Economical Dimensions ="+string(b1)+" meter");
```

Scilab code Exa 10.11 Example

```
1  //Finding of Slope
2  //Given
3  z=1;
4  y=0.225;
5  c=50;
6  q=0.04;
7  //To Find
8  A=z*y^2;
9  P=2*sqrt(2)*y;
10 x=sqrt(0.225/(2*sqrt(2)));
11 sb=q/(A*c*x);
12 sb1=sb^(2);
13 disp("Slope ="+string(sb1)+" no units");
```

Scilab code Exa 10.12 Example

```
1  //Finding of C and f
2  //Given
3  n=0.012;
4  d=0.5;
5  w=2;
6  g=9.81;
7  //To Find
8  A=w*d;
9  P=2+(w*d);
10 R=P/A;
11 C=(1/n)*(R)^(1/6);
12 f=sqrt((8*g)/(C^2));
13 disp(" C="+string(C)+" m/sec");
14 disp("f ="+string(f)+" no units");
```

Scilab code Exa 10.13 Example

```
1 //Finding of Normal Depth
2 //Given
3 w=6;
4 q=5;
5 sb=0.006;
6 n=0.014;
7 B=6;
8 //To Find
9 a=(q/(B^(8/3)*sb^(1/2)))^(3/5);
10 b=(1+(0.855)*((q/B^(8/3)*sb^(1/2)))^(3/5));
11 y=a*b;
12 disp("Normal Depth ="+string(y)+" meter");
```

Scilab code Exa 10.14 Example

```
1 //Finding of velocity , Dischage
2 //Given
3 z=1.5;
4 sb=0.0003;
5 B=10;
6 n=0.012;
7 y=3;
8 //To Find
9 A=(B+(z*y))*y;
10 P=B+(2*y)*sqrt(1+z^2);
11 R=A/P;
```

```
12 v=(1/n)*R^(2/3)*sb^(1/2);
13 q=A*v;
14 disp("Velocity ="+string(v)+" m/sec^2");
15 disp("Discharge ="+string(q)+" m^3/sec");
```

Scilab code Exa 10.16 Example

```
1 //Finding of specific energy
2 //Given
3 B=4;
4 y=2.5;
5 q=8;
6 g=9.81;
7 //To Find
8 A=B*y;
9 v=q/A;
10 E=y+(v^2/(2*g));
11 disp(" Specific Energy ="+string(E)+" meter of water
   ");
```

Scilab code Exa 10.17 Example

```
1 //Finding of Critical depth,velocity,Minimum
   Specific energy
2 //Given
3 Q=18;
4 B=6;
5 q=Q/B;
6 g=9.81;
```

```
7  //To Find
8  y=(q^2/g)^(1/3);
9  v=q/y;
10 E=(3/2)*y;
11 disp(" Critical depth ="+string(y)+" meter");
12 disp(" Critical velocity ="+string(v)+" meter");
13 disp(" Minimum Specific Energy ="+string(E)+" meter"
   );
```

Scilab code Exa 10.22 Example

```
1  //Finding of Water surface Slope
2  //Given
3  sb=1/4000;
4  sf=.00004;
5  T=10;
6  B=10;
7  g=9.81;
8  y=1.5;
9  v=1;
10 //To Find
11 A=B*y;
12 q=A*v;
13 z=(sb-sf)/(1-((q^2*T)/(g*A^3)));
14 disp("Water surface slope ="+string(z)+"no units ")
```

Scilab code Exa 10.23 Example

```
1  //Finding of discharge at section-1
```

```
2  //Given
3  T=30;
4  dy=0.06;
5  dt=3600;
6  dx=1000;
7  q2=35;
8  //To Find
9  q1=q2+((T*dy)/dt)*dx;
10 disp("Discharge at section-1 ="+string(q1)+" m^3/sec
     ");
```

Chapter 11

Laminar Flow

Scilab code Exa 11.1 Example

```
1 //Finding of Pressure Difference
2 //Given
3 mu=0.09;
4 spgr=0.8;
5 rho=800;
6 D=0.08;
7 L=15;
8 //To Find
9 A=(%pi/4)*D^2;
10 q=(50/10)*(1/rho);
11 v=q/A;
12 p=(128*mu*q*L)/(%pi*D^4);
13 p1=p/10000;
14 disp(" Pressure Difference ="+string(p1)+" N/cm^2");
```

Scilab code Exa 11.2 Example

```
1 //Finding of Pressure Drop
2 //Given
3 mu=0.15;
4 spgr=.9;
5 rho=900;
6 D=.055;
7 L=325;
8 R=D/2;
9 q=.0037;
10 //To Find
11 P=(128*mu*q*L)/(%pi*D^4);
12 p1=P/100;
13 x=(p1/L)*R;
14 x1=x*10^4;
15 disp("Pressure Drop ="+string(x1)+" N/m^2")
```

Scilab code Exa 11.3 Example

```
1 //Finding of Pressure Gradienr,Avg velocity,Reynolds
    number
2 //Given
3 mu=.5;
4 spgr=1.2;
5 rho=1200;
6 D=.1;
7 x=147.15;
8 //To Find
9 dp=-(x*4)/D;
10 dp1=-dp;
11 v=(1/(32*mu))*(-dp)*D^2;
12 R=(rho*v*D)/mu;
13 disp("Pressure Gradient ="+string(dp1)+" N/m^3");
14 disp("Average Velocity ="+string(v)+" N/m^3");
```

```
15 disp("Reynolds Number ="+string(R)+" N/m^3");
```

Scilab code Exa 11.4 Example

```
1  //Finding of Power Required
2  //Given
3  L=100;
4  D=0.1;
5  q=0.01;
6  mu=0.8;
7  //To Find
8  A=(%pi/4)*D^2;
9  v=q/A;
10 p=(32*q*mu*v*L)/D^2;
11 P=p/100;
12 disp("Power Required ="+string(P)+" KiloWatts");
```

Scilab code Exa 11.5 Example

```
1  //Finding of Pressuure gradient.Avg velocity,
     Discharge,Shear at wall
2  //Given
3  mu=0.02;
4  B=0.01;
5  b=1;
6  v=2;
7  //To Find
8  A=B*b;
9  dp=-((16*mu)/B^2);
```

```
dp1=-dp;
V=(B^2/(12*mu))*(-dp);
q=A*V;
x=(-dp*(B/2))
disp(" Pressuure Gradient ="+string(dp1)+" N/m^2 per
    meter");
disp(" Avg velocity ="+string(V)+" m/sec");
disp(" Shear at wall ="+string(x)+" N//m^2");
```

Scilab code Exa 11.6 Example

```
//Finding of Pressure Gradient , Shear at wall
//Given
D=15;
f=0.05;
r=4;
tau=0.01962;
//To Find
R=64/f;
dp=-(tau*(2/r));
dp1=-dp;
r1=D/2;
tau2=(tau*r1)/r;
disp("Pressure Gradient ="+string(dp1)+" N/m^3");
disp(" Shear at wall ="+string(tau2)+" N/cm^2");
```

Chapter 12

Turbulant Flow

Scilab code Exa 12.1 Example

```
1 //Finding the type of boundary
2 //Given
3 ks=0.20*10^-3;
4 tau=7.848;
5 nu=0.01*10^-4;
6 rho=1000;
7 //To Find
8 v=sqrt(tau/rho);
9 R=(v*ks)/nu;
10 disp("R ="+string(R)+" no units");
11 if(R>4);
12 if(R<60);
13 disp("Flow is Transitional");
```

Scilab code Exa 12.4 Example

```
//Finding of  Power Lost
//Given
D=0.6;
L=1000;
Q=0.6;
ks=0.003;
rho=1000;
g=9.81;
c=50;
//To Find
//For Turbulant Flow
A=(%pi/4)*D^2;
a=2*log(3.71*(D/ks));
b=sqrt(a);
v=Q/A;
f=1/c;
Hf=(f*L*v^2)/(2*g*D);
P=(rho*g*Q*Hf)/1000;
disp(" Power Lost ="+string(P)+" Kilowatt");
```

Scilab code Exa 12.5 Example

```
//Finding of Friction Factor
//Given
D=0.1;
ks=0.0025;
v=2;
v1=10^-6;
//To Find
//case-1
R=(v*D)/v1;
fa=(1.785*log10(R))-1.424;
a=(fa)^2;
```

```
12 f1=1/a;
13 //case-2
14 fb=2*log10((3.71*D)/ks);
15 b=(fb)^2;
16 f2=1/b;
17 //Case-3
18 fc=-(2*log10((ks/3.71*D)+(5.186/R^(0.89))));
19 c=(fc)^2;
20 f3=1/c;
21 disp(" Friction Factor for");
22 disp("Smooth Turbulent flow ="+string(f1)+" no units
     ");
23 disp("Rough Turbulent flow ="+string(f2)+" no units
    ");
24 disp("Smooth and Rough Turbulent flow ="+string(f3)+
    " no units ");
```

Chapter 13

Boundary Layer in Incompressible Flow

Scilab code Exa 13.2 Example

```
1  //Finding of Boundary layer thickness , Drag Force
2  //Given
3  x=1;
4  L=1.5;
5  b=1.2;
6  vs=0.25;
7  mu=0.001;
8  rho=1000;
9  x2=1.2;
10 L2=1.2;
11 //To Find
12 A=L*b;
13 R=(rho*vs*x)/mu;
14 t=(5.477*x)/sqrt(R);
15 tau=(0.365*mu*vs*sqrt(R))/x;
16 R1=(rho*vs*L)/mu;
17 Cd=1.46/sqrt(R1);
```

```
18 Fd=(1/2)*Cd*rho*(vs)^2*A;
19 disp("Boundary Layer Thickness ="+string(t)+" meter"
   );
20 disp("Drag Force ="+string(Fd)+" Newtons");
```

Scilab code Exa 13.3 Example

```
1  //Finding of //Finding of Boundary layer thickness ,
       Drag Force
2  //Given
3  x=1.5;
4  L=2;
5  b=1.4;
6  vs=0.2;
7  mu=0.001;
8  rho=1000;
9  //To Find
10 A=L*b;
11 R=(rho*vs*x)/mu;
12 t=(4.64*x)/sqrt(R);
13 t1=t*1000;
14 tau=(0.323*mu*vs*sqrt(R))/x;
15 R1=(rho*vs*L)/mu;
16 Cd=1.292/sqrt(R);
17 Fd=(1/2)*Cd*rho*(vs)^2*(2*A);
18 disp("Co-efficient of Drag ="+string(Cd)+" no units"
   )
19 disp("Boundary Layer Thickness ="+string(t1)+"
   millimeter");
20 disp("Drag Force ="+string(Fd)+" Newtons");
```

Chapter 14

Dimensional Analysis and Modelling Investigation

Scilab code Exa 14.6 Example

```
1 //Finding of velocity , discharge of prototype
2 //Given
3 qm=2;
4 vm=1.5;
5 lp=36;
6 lm=1;
7 //To Find
8 vp=sqrt(lp/lm)*vm;
9 qp=(lp/lm)^2*(vp/vm)*qm;
10 disp("Velocity of Prototype ="+string(vp)+" m/sec");
11 disp("Dischage of Prototype ="+string(qp)+" m^3/sec"
   );
```

Scilab code Exa 14.7 Example

```
1 //Finding of Velocity of Prototype
2 //Given
3 vm=30;
4 lm=100;
5 lp=1;
6 Am=0.018*10^-4;
7 Ap=0.012*10^-4;
8 rho1=1030;
9 rho2=1.24;
10 Fm=60;
11 //To Find
12 vp=(Ap/Am)*(lp/lm)*vm;
13 Fp=Fm*(lm/lp)^2*(vp/vm)^2*(rho1/rho2);
14 disp("Velocity of Prototype ="+string(vp)+" m/sec");
15 disp("Resistance of Prototype ="+string(Fp)+" Newton
   ");
```

Scilab code Exa 14.8 Example

```
1 //Finding of Velocity of Model
2 //Given
3 vp=20;
4 lm=1;
5 lp=15;
6 rho1=1024;
7 rho2=1000;
8 Fp=600;
9 Fm=0.12;
10 //To Find
11 vm=sqrt(lm/lp)*vp;
12 Fp=Fm*(lm/lp)^2*(vp/vm)^2*(rho1/rho2);
```

```
13 disp("Velocity of Prototype ="+string(vm)+" m/sec");
14 disp("Resistance of Prototype ="+string(Fp)+" Newton
   ");
```

Scilab code Exa 14.9 Example

```
1 //Finding of discharge through Model
2 //Given
3 A=50;
4 B=10;
5 C=sqrt(10);
6 Qp=1.5;
7 //To Find
8 D=A*B;disp(D);
9 Qm=(D)*(1/C);
10 Qm1=Qp/Qm;
11 disp(" Discharge Through Model ="+string(Qm1)+" m^3/
   sec");
```

Scilab code Exa 14.10 Example

```
1 //Finding of "n" of the Model
2 //Given
3 Lm=1;
4 Lp=64;
5 Np=0.02;
6 //To Find
7 A=sqrt(Lp/Lm);
8 Nm=A*(Lm/Lp)^(2/3)*Np;
```

```
9 disp("Manning n of the model ="+string(Nm)+" No
    units");
```

Scilab code Exa 14.11 Example

```
1 //Finding of Qm.Nm
2 //Given
3 Qp=3000;
4 Np=0.025;
5 L1=1000;
6 L2=100;
7 //To Find
8 B=sqrt(L2);
9 Qm=Qp/(L1*L2*B);
10 Nm=(Qp/Qm)*1/(((L1*L2*(L2)^(2/3))/Np)*B*sqrt(1/L1));
11 disp(" Qm ="+string(Qm)+" m^3/sec");
12 disp(" Nm ="+string(Nm)+" No units");
```

Scilab code Exa 14.12 Example

```
1 //Finding of (Vm/Vp) and (Np/Nm)
2 //Given
3 L1=1/5000;
4 L2=1/256;
5 Qr=1/(2*10^7);
6 //To Find
7 Vr=(1/L1)*(1/L2)*Qr;
8 Nr=Vr*((L2)^-(2/3)*(L2)^-(1/2)*(1/L1)^-(1/2));
9 disp("Vm/Vp ="+string(Vr)+" m/sec");
```

```
10 disp("Np/Nm =" +string(Nr)+" No units");
```

Scilab code Exa 14.13 Example

```
1  //Finding of Qm,Lm,Hm
2  //Given
3  Lp=16;
4  Lm=1;
5  Hp=4;
6  L1=150;
7  H1=7.2;
8  H2=16;
9  //To Find
10 Hm=H1*(Lm/Lp);
11 lm=L1*(Lm/Lp);
12 Qm=(Lp/Lm)^2*(Hp/H2)^(1/2);
13 disp("Lm =" +string(lm)+" meter");
14 disp("Hm =" +string(Hm)+" meter");
15 disp("Qm =" +string(Qm)+" m^3/sec");
```

Chapter 15

Compressible Flow

Scilab code Exa 15.1 Example

```
1  //Finding of Velocities
2  //Given
3  T1=293;
4  T2=293;
5  P1=40;
6  P2=35;
7  R=287;
8  A1=30*10^-4;
9  A2=15*10^-4;
10 Q=0.15;
11 //To Find
12 rho1=P1/(R*T1);
13 V1=Q/(A1*rho1*10000);
14 rho2=P2/(R*T2);
15 V2=Q/(A2*rho2*10000);
16 disp("Velocity at Section-1 ="+string(V1)+" m/sec");
17 disp("Velocity at Section-2 ="+string(V2)+" m/sec");
```

Scilab code Exa 15.2 Example

```
1 //Finding of Speed of Sound waves
2 //Given
3 k=1.4;
4 R=287;
5 T=293;
6 //To Find
7 C=sqrt(k*R*T);
8 C1=C*(18/5);
9 disp("Speed of Sound waves ="+string(C1)+" Km/hr");
```

Scilab code Exa 15.3 Example

```
1 //Finding of Mach Number
2 //Given
3 k=1.4;
4 R=287;
5 T=288;
6 V=900;
7 //To Find
8 C=sqrt(k*R*T);
9 C1=C*(18/5);
10 disp("Speed of Sound waves ="+string(C1)+" Km/hr");
11 M=V/C1;
12 disp("Mach Number = "+string(M)+" No units");
```

Scilab code Exa 15.4 Example

```
1 //Finding of Speed
2 //Given
3 k=1.4;
4 R=287;
5 T=233;
6 M=1.8;
7 //To Find
8 C=sqrt(k*R*T);
9 C1=C*(18/5);
10 V=C1*M;
11 disp("Speed of Aeroplane ="+string(V)+" Km/hr");
```

Scilab code Exa 15.5 Example

```
1 //Finding of Velocity of Projectile
2 //Given
3 theta=30;
4 k=1.4;
5 R=287;
6 T=268;
7 //To Find
8 Ma=sin(theta);
9 C=sqrt(k*R*T);
10 V=Ma*C;
11 disp("Velocity of Projectile ="+string(V)+" m/sec");
```

Scilab code Exa 15.6 Example

```
1 //Finding of Mach Number and Mach Angle
2 //Given
3 k=1.4;
4 R=287;
5 T=263;
6 V=1200;
7 //To Find
8 C=sqrt(k*R*T);
9 Ma=V/C;
10 alpha=asind(1/Ma);
11 disp("Mach Number ="+string(Ma)+" No units");
12 disp("Mach Angle ="+string(alpha)+" Degrees");
```

Scilab code Exa 15.7 Example

```
1 //Finding of Mach's Number
2 //Given
3 k=1.4;
4 R=287;
5 T=273;
6 T1=273-15;
7 v=900;
8 p1=8*10^4;
9 //To Find
10 V=v*(5/18);
11 C=sqrt(k*R*T);
```

```
12 Ma=V/C;
13 ps=p1*((1+((k-1)/2)*Ma^2)^(k/(k-1)));
14 Ps=ps*10^-4;
15 Ts=T1*((1+((k-1)/2)*Ma^2));
16 rho=ps/(R*T);
17 t=Ts-T;
18 disp("Mach Number ="+string(Ma)+" No Units");
19 disp("Density ="+string(rho)+" Kg/m^3");
20 disp("Pressure ="+string(Ps)+" N/cm^2");
21 disp("Temperature ="+string(t)+" celcius")
```

Scilab code Exa 15.8 Example

```
1 //Finding of velocity at the outlet of a nozzle
2 //Given
3 k=1.4;
4 P1=294.3;
5 P2=137.34;
6 T1=303;
7 R=287;
8 //To Find
9 rho=P1/(R*T1);
10 V2=sqrt((2*k/(k-1))*(P1/rho)*(1-(P2/P1)^((k-1)/k)));
11 disp("velocity at the outlet of a nozzle ="+string(
   V2)+" m/sec");
```

Scilab code Exa 15.9 Example

```
1 //Finding of Mass Flow Rate
```

```
2  //Given
3  D1=0.4;
4  D2=0.2;
5  P1=27.468*10^4;
6  P2=25.506*10^4;
7  T1=293;
8  k=1.4;
9  R=287;
10 //To Find
11 A1=(%pi/4)*D1^2;
12 A2=(%pi/4)*D2^2;
13 rho1=P1/(R*T1);
14 rho2=((rho1^(1.4)*P2)/P1)^(1/1.4);
15 m=rho2*A2*sqrt((2*k/(k-1))*(P1/rho1)*(1-(P2/P1)^((k
      -1/k)))/(1-(P2/P1)^(2/k))*(A2/A1)^2);
16 disp("Mass Flow Rate ="+string(m)+" Kg/sec");
```

Chapter 16

Flow of Fluid around submerged objects

Scilab code Exa 16.1 Example

```
1  //Finding of Lift,Drag,Power Required
2  //Given
3  A=4;
4  V=40*(5/18);
5  Cd1=0.8;
6  Cd2=0.2;
7  rho=1.25;
8  //To Find
9  FL=Cd1*A*rho*((V^2)/2);
10 Fd=Cd2*A*rho*((V^2)/2);
11 F=sqrt(FL^2+Fd^2);
12 P=Fd*V;
13 P1=P/1000;
14 theta=(FL/Fd);
15 theta1=(tan(theta))^-1;
16 disp("Lift Force ="+string(FL)+" Newton");
17 disp("Power Required ="+string(P1)+" Kilo Watts");
```

```
18 disp("Drag Force ="+string(Fd)+" Newton");
19 disp("Resultant Force ="+string(F)+" Newton");
20 disp("Angle of Flow Direction ="+string(theta1)+"
   degrees");
```

Scilab code Exa 16.3 Example

```
1 //Finding of Diameter
2 //Given
3 W=80*9.81;
4 Fd=80*9.81;
5 V=25;
6 Cd=0.5;
7 rho=1.25;
8 //To Find
9 D=(2*Fd)/(Cd*rho*(V^2)*(4/%pi));
10 D1=sqrt(D);
11 disp("Diameter ="+string(D1)+" meter");
```

Scilab code Exa 16.4 Example

```
1 //Finding of Coefficient of Lift ,Drag
2 //Given
3 A=25;
4 P=588.6*(7/10);
5 FL=19620;
6 V=200*(5/18);
7 rho=1000;
8 FD=7416;
```

```
9  //To Find
10 FD=(P*1000)/(V);
11 Cd=(FD*2)/(rho*A*(V^2));
12 Cl=(FL*2)/(rho*A*(V^2));
13 disp("Coefficient Of Lift ="+string(Cl)+" No Units")
      ;
14 disp("Coefficient Of Drag ="+string(Cd)+" No Units")
      ;
```

Scilab code Exa 16.5 Example

```
1  //Finding of Weight
2  //Given
3  D=0.05;
4  v=1.5*10^-4;
5  V=10;
6  rho=1.25;
7  Cd=0.5;
8  //TO Find
9  A=(%pi/4)*D^2;
10 Fd=Cd*rho*A*((V^2)/2);
11 disp("Weight of the ball ="+string(Fd)+" Newtons");
```

Scilab code Exa 16.6 Example

```
1  //Finding of Circulation, Theoretical Drag, Actual
      Drag, Lift, Resultant, Direction
2  //Given
3  V=20;
```

```
D=2;
A=2*10;
R=D/2;
N=300;
L=10;
Cd=0.65;
Cl=3.4;
rho=1000;
//To find
Vp=(%pi*D*N)/60;
//case 1
C=2*(%pi)*R*Vp;
disp("Circulation ="+string(C)+" m^2/sce");
//case 2
Fl=rho*V*L*C;
disp("Theoretical Lift ="+string(Fl)+" Newtons");
//case 3
si=C/(4*(%pi)*V*R);
theta1=(180+si);
theta2=(360-si);
disp("theta ="+string(theta1)+" Degrees");
disp("theta ="+string(theta2)+" Degrees");
//case 3
FL=0.5*rho*A*V^2*Cl;
disp("Lift Force ="+string(FL)+" Newtons");
//case 4
FD=0.5*rho*A*(V^2)*Cd;
disp("Drag Force ="+string(FD)+" Newtons");
//case 5
F=sqrt((FL^2)+(FD^2));
disp("Resultant Force ="+string(F)+" Newtons");
//case 6
theta=1/tan(FL/FD);
disp("Direction ="+string(theta)+" Degrees");
//case 7
C1=4*(%pi)*V*R;
Vp=C1/(2*(%pi)*R);
N=(Vp*60)/(2*(%pi));
```

```
42  disp("Speed =" +string(N)+" rpm");
```

Chapter 17

Impact of Jets

Scilab code Exa 17.1 Example

```
1 //Finding of Force exerted
2 //Given
3 rho=1000;
4 d=0.04;
5 V=25;
6 //To Find
7 A=(%pi/4)*d^2;
8 P=rho*A*V^2;
9 disp("Force Exerted ="+string(P)+" Newtons");
```

Scilab code Exa 17.2 Example

```
1 //Finding of Discharge
2 //Given
3 rho=1000;
```

```
4 d=0.05;
5 P=1226.25;
6 //To Find
7 A=(%pi/4)*d^2;
8 V=P/(rho*A);
9 V1=sqrt(V);
10 Q=A*V1;
11 disp("Discharge ="+string(Q)+" m^3/sec");
```

Scilab code Exa 17.3 Example

```
1 //Finding of Force Exerted
2 //Given
3 rho=1000;
4 d=0.15;
5 V=25;
6 //To Find
7 A=(%pi/4)*d^2;
8 P=rho*A*V^2*sin(%pi/6);
9 disp("Force Exerted ="+string(P)+" Newtons");
```

Scilab code Exa 17.4 Example

```
1 //Finding of Force Exerted
2 //Given
3 rho=1000;
4 d=0.04;
5 V=35;
6 theta=180-125;
```

```
7  //To FInd
8  A=(%pi/4)*d^2;
9  Fx=2*rho*A*V^2;
10 disp("Force Exerted ="+string(Fx)+" Newtons");
```

Scilab code Exa 17.5 Example

```
1  //Finding of Force Exerted
2  //Given
3  rho=1000;
4  d=0.07;
5  V=25;
6  theta=20;
7  theta2=15;
8  //To Find
9  A=(%pi/4)*d^2
10 Fx=rho*A*V^2*(sin(%pi/9)+cos(%pi/12));
11 Fy=rho*A*V^2*(sin(%pi/9)-sin(%pi/12));
12 disp("Fx ="+string(Fx)+" Newtons");
13 disp("Fy ="+string(Fy)+" Newtons");
```

Scilab code Exa 17.6 Example

```
1  //Finding of inclination
2  rho=1000;
3  d=0.03;
4  V=16;
5  w=125;
6  //To Find
```

```
A=(%pi/4)*d^2;
P=rho*A*V^2;
Q=P*(16/32);
theta=asin((rho*A*V^2)/w);
disp("Inclination ="+string(theta)+" degrees");
```

Scilab code Exa 17.7 Example

```
//Finding of Vane Angle
//Given
V=40;
u=20;
alpha=30;
b=90;
u1=20;
//TO Find
theta=atand((V*sin(%pi/6))/((V*cos(%pi/6))-u));
Vr=((V*sin(%pi/6))/(sin(theta)));
pi=acosd(u1/Vr);
disp("Vane angle at Inlet ="+string(theta)+" Degrees
   ");
disp("Vane angle at Outlet ="+string(pi)+" Degrees")
   ;
```

Scilab code Exa 17.11 Example

```
//Finding of Propelling Force,Work Done ,Efficiency
//Given
Cv=0.97;
```

```
g=9.81;
H=6;
rho=1000;
u=4;
d=0.15;
//To Find
V=Cv*sqrt(2*g*H);
A=(%pi/4)*d^2;
P=rho*A*(V+u)*V;
W=P*u;
E=(2*u*V)/(u+V)^2;
E1=E*100;
disp("Propelling Force ="+string(P)+" Newtons");
disp("Work Done ="+string(W)+" N-m");
disp("Efficiency ="+string(E1)+" Percentage");
```

Scilab code Exa 17.12 Example

```
//Finding of Propelling Force, Efficiency
//Given
u=35*(5/18);
V=25;
a=0.04;
rho=1000;
//To Find
P=rho*a*(V+u)*V;
E=(2*u)/(V+(2*u));
E1=E*100;
disp("Propelling Force ="+string(P)+" Newtons");
disp("Efficiency ="+string(E1)+" No Units");
```

Chapter 18

TurbomachinesHydraulic Turbines

Scilab code Exa 18.1 Example

```
1  //Finding of Power delivered , Efficiency
2  //Given
3  u=35;
4  Q=1;
5  theta=10;
6  H=270;
7  Cv=0.98;
8  g=9.81;
9  rho=1000;
10 //To Find
11 V=Cv*sqrt(2*g*H);
12 Vr=V-u;
13 Vw1=Vr*cos(%pi/18)-u;
14 W=rho*(Q*(V+Vw1)*u);
15 P=W/1000;
16 E=(2*(V+Vw1)*u)/V^2;
17 E1=E*100;
```

```
18 disp("Power delivered ="+string(P)+" Kilo watts");
19 disp("Hydraulic Efficiency ="+string(E1)+"
     percentage");
```

Scilab code Exa 18.2 Example

```
1  //Finding of D,d number of jets
2  //Given
3  E=0.86;
4  Dr=10;
5  Cv=0.98;
6  a=0.45;
7  Sp=735.75*1000;
8  H=200;
9  g=9.81;
10 N=800;
11 rho=1000;
12 //To Find
13 V=Cv*sqrt(2*g*H);
14 u=V*a;
15 D=(60*u)/(%pi*N);
16 d=(D/10);
17 Q1=(%pi/4)*(d^2)*V;
18 Q2=1/((E*rho*g*H)/Sp);
19 j=Q2/Q1;disp(Q2);
20 disp("D= "+string(D)+" meter");
21 disp("d= "+string(d)+" meter");
22 disp("Number of Jets ="+string(j)+" nos");
```

Scilab code Exa 18.3 Example

```
1 //Finding of Power ,Efficiency
2 //Given
3 D=0.8;
4 N=1000;
5 a=15;
6 Q=0.15;
7 Cv=0.98;
8 rho=1000'
9 g=9.81;
10 H=400;
11 //To Find
12 u=(%pi*D*N)/60;
13 V=Cv*sqrt(2*g*H);
14 P=(rho*g*Q*H)/1000;
15 E=2*(V-u)*(1+cos(%pi/12))*u
16 E1=(E/V^2)*100;
17 disp("Power available ="+string(P)+" Kilo watts");
18 disp("Hydraulic efficiency ="+string(E1)+"
   percentage");
```

Scilab code Exa 18.4 Example

```
1 //Finding of Power delivered , Efficiency
2 //Given
3 Q=1.8;
4 theta=12;
5 Hg=450;
6 H=300;
7 hf=Hg/3;
8 Cv=0.98;
9 g=9.81;
```

```
a=0.46;
rho=1000;
//To Find
V=Cv*sqrt(2*g*H);
u=a*V;
Vr=V-u;disp(V);
Vw1=Vr*cos(%pi/15)-u;
W=rho*(Q*(V+Vw1)*u);
P=W/1000;disp(V);
E=(2*(V+Vw1)*u)/V^2;
E1=E*100;
disp("Power delivered ="+string(P)+" Kilo watts");
disp("Hydraulic Efficiency ="+string(E1)+"
   percentage");
```

Scilab code Exa 18.5 Example

```
//Finding of Power Developed ,Force Exerted
//Given
d=0.13;
a=15;
H=400;
Cv=0.97;
b=0.45;
g=9.81;
rho=1000;
//To Find
A=(%pi/4)*d^2;
u=b*sqrt(2*g*H);
V=0.97*sqrt(2*g*H);
Vr1=0.8*(V-u);
Vw1=u-(Vr1*cos(%pi/15));
Fx=rho*A*V*(V-Vw1);
```

```
17 P=(Fx*u)/1000;
18 disp("Force Exerted ="+string(Fx)+" Newton");
19 disp("Power developed ="+string(P)+" Kilo Watts");
```

Scilab code Exa 18.6 Example

```
1 //Finding of Discharge, Width
2 //Given
3 D=1.2;
4 D1=0.6;
5 Vf=1.8;
6 B=.20;
7 //To Find
8 Q=(%pi*D*B*Vf);
9 B1=((D*B)/D1)*100;
10 disp("Discharge ="+string(Q)+" m^3/sec");
11 disp("Width ="+string(B1)+" centimeter");
```

Scilab code Exa 18.7 Example

```
1 //Finding of Discharge,Power developed,Efficiency
2 //Given
3 N=500;
4 H=100;
5 D=1;
6 A=35;
7 a=15;
8 b=60;
9 Vw1=0;
```

```
g=9.81;
rho=1000;
//To Find
u=(%pi*D*N)/60;
Vw=(tan(%pi/3)*u)/1.464;
Vf=Vw*tan(%pi/12);
Q=A*Vf;
P=(rho*g*Vw*u)/1000;
E=((Vw*u)/(g*H))*100;
disp("Discharge ="+string(Q)+" m^3/sec");
disp("Power Developed ="+string(P)+" Kilo Watts");
disp("Efficiency ="+string(E)+" Percentage");
```

Scilab code Exa 18.8 Example

```
//Finding of Power developed,Outlet Vane Angle ,
   Speed
//Given
H=100;
D=.675;
D1=0.5
B=0.15;
B1=.225;
g=9.81;
rho=1000;
Vf=3;
Vw=3;
//To Find
u=Vf/tan(%pi/15);
N=1/((%pi*D)/(u*60));
u1=u*(D1/D);disp(Vf);
Vf1=(D*B*Vf)/(0.15*B1);
z=atand(Vf1/u1);
P=(rho*%pi*B*D1*Vf*Vw*u)/10000;
disp("Speed ="+string(N)+" rpm");
```

```
20 disp("Power Developed ="+string(P)+" Kilo Watts");
21 disp("Outlet Vane Angle ="+string(z)+" degrees");
```

Scilab code Exa 18.9 Example

```
1  //Finding of Work Done ,Vane Angles
2  //Given
3  D=0.5;
4  D1=1;
5  Vw1=0;
6  Vf=3;
7  Vf1=3;
8  g=9.81;
9  rho=1000;
10 N=250;
11 //To Find
12 u=(%pi*D*N)/60;
13 u1=(%pi*D1*N)/60;
14 Vw=Vf/tan(%pi/12);
15 a=atand(Vf/(Vw-u));
16 b=atand(Vf1/u1);
17 W=(Vw*u)/g;
18 E=(W/10);
19 disp("Inlet Vane Angle ="+string(a)+" degrees");
20 disp("Outlet Vane Angle ="+string(b)+" degrees");
21 disp("Work Done ="+string(W)+" N-m/N");
22 disp("Efficiency ="+string(E)+" Percentage");
```

Scilab code Exa 18.10 Example

```
1  //Finding of Vane Angle ,Head ,Velocity ,Efficiency
2  //Given
3  u=12;
4  D=0.8;
5  D1=1;
6  Vw1=0;
7  Hout=1;
8  Vw=12;
9  Vf=3;
10 g=9.81;
11 //To Find
12 a=atand(Vf/Vw);
13 V=sqrt(Vw^2+Vf^2);
14 u1=(D1/D)*u;
15 V1=u1*tan(%pi/9);
16 H=((V1^2/(2*g))+1)+((Vw*u)/g);
17 E=((Vw*u)/(g*H))*100;
18 disp("Absolute Velocity ="+string(V)+" m/sec");
19 disp("Vane Angle ="+string(a)+" degrees");
20 disp("Efficiency ="+string(E)+" Percentage");
```

Scilab code Exa 18.11 Example

```
1  //Finding of Angle ,Diameter ,Width
2  //Given
3  E=0.75;
4  P=147.15;
5  H=8;
6  N=200;
7  Vw1=0;
8  Cv=0.3;
9  g=9.81;
10 rho=1000;
```

```
11 //To Find
12 u=Cv*sqrt(2*g*H);
13 Vf=0.96*sqrt(2*g*H);
14 E1=0.8;
15 Vw=(E1*g*H)/u;
16 a=atand(Vf/Vw);
17 b=atand(Vf/(Vw-u));
18 D=(60*u)/(%pi*N);
19 Q=(E1*P*1000)/(E*rho*Vw*u);
20 B=Q/(%pi*D*Vf);
21 disp("Diameter ="+string(D)+" meter");
22 disp(" Inlet angle ="+string(a)+" degrees");
23 disp(" Outlet angle ="+string(b)+" degrees");
24 disp("Width ="+string(B)+" meter");
```

Scilab code Exa 18.14 Example

```
1 //Finding of Pressure Head ,Efficiency
2 //Given
3 Di=0.8;
4 Do=1.2;
5 V2=3;
6 L=8;
7 y=2;
8 Hs=6;
9 g=9.81;
10 //To Find
11 Q=(%pi/4)*Do^2*V2;
12 V1=Q/((%pi/4)*Di^2);
13 a=(V1^2/(2*g))-(V2^2/(2*g));
14 b=0.25*(V2^2/(2*g));
```

```
15 P=10.3-Hs-a-b;
16 E=(a-b)/(V1^2/(2*g));
17 E1=E*100;disp(V1);
18 disp("Pressure Head ="+string(P)+" meter of water");
19 disp("Efficiency ="+string(E1)+" Percentage");
```

Scilab code Exa 18.15 Example

```
1 //Finding of Speed ,Power developed
2 //Given
3 P1=8000;
4 N1=90;
5 H1=25;
6 H2=15;
7 //To Find
8 N2=N1*(sqrt(H2)/sqrt(H1));
9 P2=(P1*(H2)^(3/2))/(H1)^(3/2);
10 disp("Speed ="+string(N2)+" rpm");
11 disp("Power Developed ="+string(P2)+" Kilo watts");
```

Scilab code Exa 18.16 Example

```
1 //Finding of Specific speed,Power generated
2 //Given
3 H=30;
4 N=300;
5 Q=10;
6 E=0.9;
7 g=9.81;
```

```
rho=1000;
//To Find
P=(E*rho*g*Q*H)/1000;
Ns=(N*sqrt(P))/(H)^(5/4);
disp("Power Developed ="+string(P)+" Kilowatts");
disp("Specific Speed ="+string(Ns)+" rpm");
```

Chapter 19

Centrifugal Pumps

Scilab code Exa 19.1 Example

```
1  //Finding of workdone
2  //Given
3  D1=.6;
4  D=0.3;
5  a=20;
6  b=30;
7  N=1000;
8  g=9.81;
9  Vw=0;
10 rho=1000;
11 //To Find
12 u=(%pi*D*N)/60;
13 u1=(%pi*D1*N)/60;
14 Vf=u*tan(%pi/9);
15 Vw1=(u1*tan(%pi/6)-Vf)/tan(%pi/6);
16 W=(Vw1*u1)/g;
17 disp("Work Done ="+string(W)+" N-m/N");
```

Scilab code Exa 19.2 Example

```
1  //Finding of vane angle , Work done , Efficiency
2  //Given
3  D1=0.6;
4  D=0.3;
5  a=30;
6  b=0.05;
7  N=1200;
8  g=9.81;
9  Hm=75;
10 Vf=3;
11 rho=1000;
12 B1=1;
13 //To Find
14 u=(%pi*D*N)/60;
15 u1=(%pi*D1*N)/60;
16 Q=%pi*D1*B1*Vf;
17 a=atand(Vf/u);disp(u1);
18 Vw1=((u1*tan(%pi/6))-Vf)/tan(%pi/6);
19 W=(rho*g*Q*u1*Vw1)/g;
20 W1=W/1000;
21 E=((g*Hm)/(u1*Vw1))*100;
22 disp("Vane Angle ="+string(a)+" degrees");
23 disp("Work Done ="+string(W1)+" KW/sec");
24 disp("Manometric Efficiency ="+string(E)+"
     Percentage");
```

Scilab code Exa 19.3 Example

```
1 //Finding of Workdone
2 //Given
3 D1=0.3;
4 D=0.15;
5 a=30;
6 b=25;
7 N=1450;
8 g=9.81;
9 //To Find
10 u=(%pi*D1*N)/60;
11 u1=(%pi*D*N)/60;
12 Vf=u*tan(%pi/6);
13 Vw1=(-u1*tan(%pi/7)+Vf)/tan(%pi/7);
14 W=(Vw1*u1)/g;
15 disp("Work Done =" +string(W)+" Nm/N");
```

Scilab code Exa 19.4 Example

```
1 //Finding of Vane Angle
2 //Given
3 N=1450;
4 Hm=23;
5 D1=0.25;
6 B1=0.05;
7 Emano=0.75;
8 g=9.81;
9 Q=1.25;
10 //To Find
11 u=(%pi*D1*N)/60;
12 Vw1=(Emano*u)/(g*Hm);
13 z=u-Vw1;
```

```
Vf1=z*tan(%pi/6);
Vf1=Q/(%pi*D1*B1);
a=Vf1/(u-Vw1);
b=atand(a);
disp("Vane Angle ="+string(b)+" degrees");
```

Scilab code Exa 19.5 Example

```
//Finding of Discharge
//Given
N=1000;
Hm=15;
D1=0.3;
B1=0.05;
a=30;
Emano=0.92;
g=9.81;
//To Find
u=(%pi*D1*N)/60;
Vw1=(Emano*u)/(g*Hm);
z=u-Vw1;
Vf1=z*tan(%pi/6);
Q=%pi*D1*B1*Vf1;
disp("Discharge ="+string(Q)+" m^3/sec");
```

Scilab code Exa 19.6 Example

```
//Finding of Power Required
//Given
```

```
3  Q=0.03;
4  H=18.25;
5  L=90;
6  dp=0.1;
7  E=0.75;
8  f=0.04;
9  g=9.81;
10 rho=1000;
11 //Given
12 V=Q/((%pi/4)*dp^2);
13 loss=(f*L*V^2)/(2*g*dp);
14 a=V^2/(2*g);
15 Hm=H+loss+a;
16 SP=(rho*g*Q*Hm)/(E*1000);
17 disp("Power required ="+string(SP)+" Kilowatts");
```

Scilab code Exa 19.7 Example

```
1  //Finding of Minimum Speed
2  //Given
3  Hm=7.5;
4  D1=1;
5  D=0.5;
6  g=9.81;
7  //To Find
8  u=(4/3)*(Hm*2*g);
9  u1=sqrt(u);
10 N=(60*u1)/(4*%pi);
11 disp(" u="+string(u1)+" m/sec");
12 disp("Minimum Speed ="+string(N)+" rpm");
```

Scilab code Exa 19.8 Example

```
1 //Finding of Mininmum Speed
2 //Given
3 D=0.3;
4 D1=0.6;
5 Vf1=2.5;
6 a=45;
7 Emano=0.75;
8 //To Find
9 u=(%pi*D)/60;
10 N=(-2.5)*(120*Emano**D1)/(%pi*(D1^2-D^2));
11 N1=-N+(1/u);
12 disp("Speed ="+string(N1)+" rpm");
```

Scilab code Exa 19.9 Example

```
1 //Finding of Manometric head
2 //Given
3 D1=0.4;
4 B1=0.025;
5 Q=0.06;
6 N=1000;
7 a=30;
8 g=9.81;
9 Emano=0.8;
10 //To Find
11 u=(%pi*D1*N)/60;
```

```
12 Vf=Q/(%pi*D1*B1);
13 Vw1=(-Vf*tan(%pi/6)+u);
14 H=(Vw1*u)/g;
15 Hm=(Emano*u*Vw1)/g;
16 Hm1=2*Hm;
17 disp("Head Developed ="+string(Hm1)+" meter");
```

Scilab code Exa 19.10 Example

```
1 //Finding of Head , Shaft Power
2 //Given
3 n=3;
4 D1=0.4;
5 B1=0.025;
6 a=30;
7 A=0.15;
8 A1=0.0267;
9 Emano=0.85;
10 E=0.75;
11 Q=0.06;
12 N=1200;
13 g=9.81;
14 rho=1000;
15 //To Find
16 V=Q/A1;disp(V);
17 u=(%pi*D1*N)/60;
18 Vw1=(u*tan(%pi/6)-V)/tan(%pi/6);
19 Hm=(Emano*u*Vw1)/g;
20 Hm1=3*Hm;
21 SP=(rho*g*Q*Hm1)/(1000*E);
22 disp("Head ="+string(Hm1)+" meter");
23 disp("Shaft Power ="+string(SP)+" Kilo watts");
```

Scilab code Exa 19.11 Example

```
1 //Finding of Number of pumps
2 //Given
3 H=156;
4 N=1000;
5 Ns=20;
6 Q=0.15;
7 //To Find
8 Hm=(N*sqrt(Q))/Ns;
9 Hm1=(Hm)^(4/3);
10 pumps=(H/Hm1);
11 disp("Number of Pumps ="+string(pumps)+" Nos");
```

Scilab code Exa 19.12 Example

```
1 //Finding of Head Discharge , Ratio of Power
2 //Given
3 Q1=0.035;
4 H1=25;
5 D1=0.5;
6 N1=1200;
7 D2=0.3;
8 N2=2000;
9 //To Find
10 H=(D2*N2*sqrt(H1))/(D1*N1);
11 H2=H^2;
12 Q=(Q1*D2^3*N2)/(D1^3*N1);
```

```
13 Pr=(D1/D2)^5*(N1/N2)^3;
14 disp("Head ="+string(H2)+" meter");
15 disp("Discharge ="+string(Q)+" m^3/sec");
16 disp("Power Ratio ="+string(Pr)+" No Units");
```

Chapter 20

Reciprocating Pumps

Scilab code Exa 20.1 Example

```
1 //Finding of theoretical discharge ,Coefficient of
    Discharge ,Slip
2 //Given
3 N=30;
4 Qac=0.012;
5 d=0.25;
6 L=0.5;
7 //To Find
8 A=(%pi/4)*d^2;
9 Qth=(A*L*N)/60;
10 S=Qth-Qac;
11 Cd=Qac/Qth;
12 S1=((Qth-Qac)/Qth)*100;
13 disp("Theoretical Discharge ="+string(Qth)+" m^3/sec
    ");
14 disp("Co efficient of Discharge ="+string(Cd)+" No
    Units");
15 disp("Slip ="+string(S)+" m^3/sec");
16 disp("Percentage Slip ="+string(S1)+" No Units");
```

Scilab code Exa 20.2 Example

```
1 //Finding of Slip ,Power required
2 //Given
3 N=50;
4 Qac=0.015;
5 L=0.4;
6 D=0.25;
7 hd=25;
8 hs=4;
9 rho=1000;
10 g=9.81;
11 //To Find
12 A=(%pi/4)*D^2;
13 Qth=(2*A*L*N)/60;
14 S=Qth-Qac;
15 P=((2*rho*g*A*L*N)*(hs+hd))/60000;
16 disp("Slip ="+string(S)+" m^3.sec");
17 disp("Power required ="+string(P)+" Kilo Watts");
```

Scilab code Exa 20.3 Example

```
1 //Finding of Pressure Head
2 //Given
3 D=0.15;
4 L=0.3;
5 hs=4;
```

```
N=40;
l=5;
ds=0.1;
p=10.3;
g=9.81;
//To Find
A=(%pi/4)*D^2;
a=(%pi/4)*(ds)^2;
r=L/2;
Z=(2*%pi*N)/60;
ha=(l/g)*(A/a)*r*Z^2;
disp("Pressure Head ="+string(ha)+" meter");
```

Scilab code Exa 20.4 Example

```
//Finding of Qth ,Pth ,ha
//Given
D=0.15;
L=0.3;
N=50;
H=25;
ld=22;
dd=0.1;
Qac=0.0042;
rho=1000;
g=9.81;
//To Find
A=(%pi/4)*D^2;
a=(%pi/4)*(dd)^2;
Z=(2*%pi*N)/60;
r=L/2;
Qth=(A*L*N)/60;
Pth=(rho*g*Qth*H)/1000;
```

```
19 S1=((Qth-Qac)/Qth)*100;
20 ha=(ld/g)*(A/a)*r*Z^2;
21 disp("Qth ="+string(Qth)+" m^3/sec");
22 disp("Pth ="+string(Pth)+" Kilo Watts");
23 disp("ha ="+string(ha)+" meter");
```

Scilab code Exa 20.5 Example

```
1 //Finding of Pmax ,Pressure at begining and end of
    Stroke
2 //Given
3 D=0.2;
4 L=0.4;
5 l=6;
6 ds=0.1;
7 hs=3.5;
8 H=10.3;
9 N=35;
10 g=9.81;
11 //To Find
12 A=(%pi/4)*D^2;
13 a=(%pi/4)*(ds)^2;
14 r=L/2;
15 Z=(2*%pi*N)/60;
16 Pmax=(l/g)*(A/a)*r*Z^2;
17 P=hs+Pmax;
18 P1=H-P;
19 disp("Pmax ="+string(Pmax)+" meter");
20 disp("Pressure at Begining ="+string(P)+" meter");
21 disp("Pressure at End ="+string(P1)+" meter");
```

Scilab code Exa 20.6 Example

```
1  //Finding of Maximum Speed
2  //Given
3  D=0.125;
4  L=0.3;
5  hs=4.5;
6  ds=0.075;
7  l=6.8;
8  h=2.6;
9  g=9.81;
10 H=10.3;
11 //TO Find
12 A=(%pi/4)*D^2;
13 a=(%pi/4)*(ds)^2;
14 r=L/2;
15 ha=H-h-hs;
16 Z=(ha*g*a)/(l*A*r);
17 Z1=sqrt(Z);
18 N=(Z1*60)/(2*%pi);
19 disp("Maximum Speed ="+string(N)+" rpm");
```

Chapter 21

Miscellaneous Fluid

Scilab code Exa 21.2 Example

```
1  //Finding of Force,Power,strokes
2  //Given
3  d1=0.3;
4  d2=0.15;
5  W=600;
6  d=1.2;
7  s=0.25;
8  //To Find
9  A1=(%pi/4)*d1^2;
10 A2=(%pi/4)*d2^2;
11 F=(A1/A2)*W;
12 W1=W*(d/1200);
13 P=W1/1000;
14 S=(A1/A2)*(d/s);
15 disp("Force ="+string(F)+" Newtons");
16 disp("Power required ="+string(P)+" Kilo Watts");
17 disp("Number of strokes ="+string(S)+" No units");
```

Scilab code Exa 21.3 Example

```
1 //Finding of Efficiency
2 //Given
3 W=0.03;
4 rho=1000;
5 g=9.81;
6 w=0.003;
7 H1=4;
8 H2=18;
9 //To Find
10 W1=rho*g*W;
11 w1=rho*g*w;
12 E1=(w1*H2)/(W1*H1)*100;
13 E2=(w1*(H2-H1))/((W1-w1)*H1)*100;
14 disp("D Aubuissons Efficiency ="+string(E1)+"
     percentage");
15 disp("Rankine Efficiency ="+string(E2)+" percentage"
     );
```

Scilab code Exa 21.4 Example

```
1 //Finding of Power, Working ,Idle Period
2 //Given
3 H=12;
4 t=100;
5 W=98100;
6 v=0.6;
```

```
w=981*12;
//To Find
P=w/1000;
T1=H/v;
T2=100-T1;
disp("Power Required ="+string(P)+" Kilo watt");
disp("Time for working ="+string(T1)+" seconds");
disp("Idle Time ="+string(T2)+" seconds");
```

Scilab code Exa 21.7 Example

```
//Finding of Volume ,Diameter
//Given
L=44145;
H=10;
E=0.55;
P=490.5*10^4;
//To Find
W=L*H;
F=P*(%pi/4);
Energy=F*5;
d=W/(Energy*E);
d1=d^(.33);
V=((%pi/4)*d1^2)*(5*d1);
disp("Diameter ="+string(d1)+" meter");
disp("Volume ="+string(V)+" m^3");
```

Scilab code Exa 21.9 Example

```
1 //Finding of Pressure intensity
2 //Given
3 P=17;
4 D=12;
5 d=5;
6 //To Find
7 A=(%pi/4)*D^2;
8 a=(%pi/4)*d^2;
9 p=(A/a)*P;
10 disp("Pressure Intensity ="+string(p)+" N/cm^2");
```

Scilab code Exa 21.10 Example

```
1 //Finding of Diameter
2 //Given
3 D=25;
4 P1=25;
5 P2=120;
6 //To Find
7 A=(%pi/4)*D^2;
8 d=(A*P1)/P2;
9 d1=sqrt(d);
10 disp("Diameter ="+string(d1)+" centimeter");
```

Scilab code Exa 21.11 Example

```
1 //Finding of load on Ram
2 //Given
3 D=0.2;
```

```
4 L=6;
5 p=588.6*10^4;
6 //To Find
7 A=(%pi/4)*D^2;
8 W=p*A;
9 capacity=W*L;
10 disp("Load ="+string(W)+" Newtons");
11 disp("Capacity of the accumulator ="+string(capacity
    )+" N-m");
```

Scilab code Exa 21.12 Example

```
1 //Finding of Pressure of water
2 //Given
3 W=490500;
4 Fr=39240;
5 d=40;
6 //To Find
7 A=(%pi/4)*d^2;
8 Wu=W+Fr;
9 P1=Wu/A;
10 Wd=W-Fr;
11 P2=Wd/A;
12 disp("Pressure while moving up ="+string(P1)+" N/cm
    ^2");
13 disp("Pressure while moving down ="+string(P2)+" N/
    cm^2");
```

Scilab code Exa 21.13 Example

```
//Finding of Power delivered
//Given
L=(588600-(588600*4)/100);
d=35;
l=5;
q=0.008;
t1=2.5*60;
rho=1000;
g=9.81;
//To Find
A=(%pi/4)*d^2;
P=L/A;
P1=P*10^4;
H=P1/(rho*g);
W1=q*1000*g*H;
W2=L*l/t1;
W3=W1+W2;
W4=W3/1000;
disp("Power Delivered ="+string(W4)+" Kilo Watts");
```

Scilab code Exa 21.14 Example

```
//Finding of Efficiency ,Slip
//Given
Nb=780;
Na=800;
//To Find
E=Nb/Na;
E1=E*100;
S=100-E1;
disp("Efficiency ="+string(E1)+" percentage");
disp("Slip ="+string(S)+" Percentage");
```