Scilab Textbook Companion for
Elementary Fluid Mechanics
by J. K. Vennard[1]

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Book Description

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

Contents

List of Scilab Codes

Chapter 1

Fundamentals

Scilab code Exa 1.1 Chapter 1 Example 1

```
clear;
clc;
//page no.8

T = 80;//temperature of chlorine gas in degree F
p = 100;//pressure in psia
W = 2*35.45;//molecular weight of chlorine
R = 1545/W;//specific gas constant in ft-lb/lb-
    degreeR
gam = p*(144/R)*(1/(460+T));//specific weight of
    chlorine in lb/cuft
Spec_vol = 1/gam;//specific volume in cuft/lb
rho = gam/32.2;//density of chlorine in slug/cuft
printf('Spec. weight = %.3f lb/cuft\n Spec. volume =
    %.3f cuft/lb\n density = %.4f slug/cuft',gam,
    Spec_vol,rho);
```

Scilab code Exa 1.2 Chapter 1 Example 2

```
clear;
clc;
//page no. 12

funcprot(0);
gamma = 1.4;
T1 = 60;//temperature of air in degree F
p1 = 14.7;//pressure in psia
k = 0.5;//(final volume/initial volume) = k
R = 53.3;//Engineering gas constant
gam1 = p1*(144/R)*(1/(460+T1));//lb/cuft
gam2 = gam1/k;//lb/cuft
p2 = (p1/(gam1^(gamma)))*(gam2^(gamma));// in psia
T2 = p2*(144/R)*(1/gam2);//in degree F
a1 = sqrt(gamma*32.2*R*(460+T1));// in fps
a2 = sqrt(gamma*32.2*R*(T2));// in fps
printf('Final pressure = %.1f psia\n Final
   temperature = %d degreeR \n Sonic velocity before
    compression = %d fps\n Sonic velocity after
   compression = %d fps',p2,T2,a1,a2);

//there are small errors in the answers given in
   textbook
```

Scilab code Exa 1.3 Chapter 1 Example 3

```
clear;
clc;
//page no. 17

r1 = 0.25;// radius of cylinder in feet
l = 2;//length of cylnider in feet
r2 = 0.30;// radius of co-axial cylinder in feet
mu = 0.018;//lb-sec/ft^2
torque = 0.25;// in ft-lb
```

```
dv_dy1 = torque/(4*%pi*mu*r1^2);//velocity gradient at radius = 0.25 in fps/ft
dv_dy2 = torque/(4*%pi*mu*r2^2);//velocity gradient at radius = 0.30 in fps/ft
V1 = integrate('-torque/(4*%pi*mu*r^2)','r',r2,r1);// velocity in fps
rpm1 = V1*60/(2*%pi*r1);
V2 = torque*(r2-r1)/(4*%pi*mu*r1^2);//in fps
rpm2 = V2*60/(2*%pi*r1);
hp = 2*%pi*r1*(rpm1/(550*60));
printf('Velocity gradient at the inner cylinder wall is %.1f fps/ft and \n at the outer cylinder wall is %.1f fps/ft',dv_dy1,dv_dy2);
printf('\n rpm = %.1f  and approximate rpm = %.1f \n hp = %.5f  ',rpm1,rpm2,hp);
```

Scilab code Exa 1.4 Chapter 1 Example 4

```
clear;
clc;

//page no.20

T = 70;//degreeF
del_p = 0.1;// in psi
sigma = 0.00498;// lb/ft
R = (sigma*2)/(del_p*144);//in ft
d = 12*2*R;// in inches
printf('Diameter of the droplet of water, d = %.4f in',d);
```

Scilab code Exa 1.5 Chapter 1 Example 5

```
clear;
clc;

//page no. 20

l = 12;// length of the cylinder
T = 150;//temperature of water in degreeF
p1 = 14.52;//atmospheric pressure in psia
p2 = 3.72;//the pressure on the inside of the piston
    in psia
F = 0.25*(p1-p2)*%pi*l^2;//Force on the piston in lb
printf('Minimum force on the piston to be applied is
    , F = %d lb.',F);

//there is an error in the answer given in textbook
```

Chapter 2

Fluid Statics

Scilab code Exa 2.1 Chapter 2 Example 1

```
clear;
clc;

//page no.32
T = 68;//degreeF
p = 10;// psi
d = 15;// feet
rho = 1.59;//specific gravity
gam = rho*62.4;//lb/cuft
p1 = gam*d + p*144;//psf
printf('p1 = %d psf = %.1f psi ',p1,p1*0.00694);

//there is an error in the answer given in the
   textbook
```

Scilab code Exa 2.2 Chapter 2 Example 2

```
clear;
```

```
clc;

//page no.32
h = 35000;// feet
p1 = 14.7;// psia
T1 = 519;// degreeR
gam1 = 0.0765;// lb/cuft
p2 = 504;// psfa
T2 = T1 - h*0.00356;// degreeR
gam2 = p2/(53.3*T2);// lb/cuft
printf('p2 = %d psfa = %.2f psia\n specific weight =
    %.3f lb/cuft',p2,p2*0.00695,gam2);
```

Scilab code Exa 2.3 Chapter 2 Example 3

```
clear;
clc;

//page no.35

h1 = 12.5;// inches
p1 = 14.50;// psia
p = p1 - h1*14.70/29.92;//absolute pressure in psia
printf('Absolute pressure = %.2f psia',p);
```

Scilab code Exa 2.4 Chapter 2 Example 4

```
clear;
clc;

//page no.37
gam1 = 0.9*62.4;
gam2 = 13.55*62.4;
```

```
l1 = 10;// feet
l2 = 15/12;// feet
p_x = gam2*l2 - gam1*l1;// psf
printf('The gauge reading = %d psf = %.2f psi',p_x
    ,0.00694*p_x);
```

Scilab code Exa 2.5 Chapter 2 Example 5

```
clear;
clc;

//page no. 42

l1 = 4;// feet
b1 = 6;// feet
b2 = 6;// feet
l2 = 2.55;// feet
t = 1;// feet
F1 = 0.5*l1*b1*62.4*(0.5*l1 + t) ;// lb
F2 = 0.25*%pi*b2^2 *62.4*(l2 + t);// lb
a1 = l1*b2^3 /(36*0.5*b2*0.5*l1*b1);// feet
a2 = 70/((0.5*l2 + t)*28.3);// feet
l_p = (F1*(0.5*l1 + a1)+F2*(l2+a2))/(F1+F2) +1;//
    feet
x_p1 = (0.5*l1-a1) - a1*2/b2;// feet
M = integrate('(62.4/2)*(36-y^2)*(y+1)','y',0,6);//
    ft-lb
x_p2 = M/F2;// feet
x_p = (x_p2*F2 - F1*x_p1)/(F1+F2);// feet
printf('Total force on composite area is %d lb',F1+
    F2);
printf('\n Vertical location of resultant force is %
    .2f ft below the water surface',l_p);
printf('\n Horizontal location of resultant force is
     %.3f ft right of the water surface',x_p);
```

```

//there are errors in the answer given in textbook
```

Scilab code Exa 2.6 Chapter 2 Example 6

```
clear;
clc;

//page no.45

l = 8;//feet
b = 10;// feet
F_h = 0.5*l*b*62.4*(b+2.5);// lb
x = 83.2/(40*(b+2.5));// feet
F_v = (b+5)*62.4*40-(l*62.4*(25 - 0.25*%pi*25));// lb
F = sqrt(F_h^2 + F_v^2);// lb
e = (2680*3.91 + 37440*(0.25*b))/F_v ;// feet
theta = 180*atan(F_v/F_h) /%pi;// degrees
x_p = 0.25*b-x;// feet
printf('Magnitude of resultant force is %d lb',F);
printf('\n Theta = %d degrees',theta);
printf('\n Location is %.3f feet above and %.2f feet to the right of B',x_p,e);

//there are errors in the answer given in textbook
```

Scilab code Exa 2.7 Chapter 2 Example 7

```
clear;
clc;

//page no.48
```

```

A = 4000;// sq.ft
d1 = 10;// feet
d2 = 2;// inches
rho = 64;// lb/cuft
W = A*(d2/12)*rho;// lb
printf('Weight of cargo = %d lb',W);

//there is an error in the answer given in textbook
```

Scilab code Exa 2.8 Chapter 2 Example 8

```
clear;
clc;

//page no. 48

gam = 53.0;// lb/cuft
D = 17;// inches
d = 12;// inches
V = (%pi/6)*(D/12)^3;
V1 = 0.584;//cuft
V2 = 0.711;//cuft
W = V*gam;
F_B = V1*62.4;
F_ACA = (V2)*62.4;
F = W+F_ACA-F_B;
printf('The force exerted between sphere and orfice
    plate = %.1f lb',F);

//there is an error in the answer given in textbook
```

Scilab code Exa 2.9 Chapter 2 Example 9

```
clear;
clc;

//page no. 51

v = 15;// ft/sec^2
d = 5;// ft
p = integrate('-62.4*(v+32.2)/32.2','z',0,-5);
printf('p = %d psf',p);
```

Scilab code Exa 2.10 Chapter 2 Example 10

```
clear;
clc;

//page no. 52

m = -0.229;//slope
a_z = 1.96;// ft/sec^2
a_x = 4*a_z;// ft/sec^2
a = sqrt(a_x^2 + a_z^2);// ft/sec^2
p = integrate('-(32.2 + a_z)*(62.4/32.2)','z',0,-2.75);
printf('p = %.1f psf',p);

//there is an error in the answer given in textbook
```

Scilab code Exa 2.11 Chapter 2 Example 11

```
clear;
clc;

//page no. 54
```

```
l1 = 2;// feet
l2 = 3;// feet
rpm = 100;
p_A = (l1+l2)-(2/3)*(2*%pi*rpm/60)^2 /(2*32.2);
p_B = (l1+l2)+(1/3)*(2*%pi*rpm/60)^2 /(2*32.2);
printf('Pressure heads at point A and point B
    respectively are %.2f ft , %.2f ft',p_A,p_B);
```

Chapter 3

Kinematics of Fluid Motion

Scilab code Exa 3.1 Chapter 3 Example 1

```
clear;
clc;

//page no. 83

v_mag = 3;
x = 8;
y = 6;
s = sqrt(x^2 + y^2);
v = v_mag*s;// fps
a_t = v_mag*s*v_mag;// ft/sec^2
a_r = 0;
a = sqrt(a_r^2 + a_t^2);
printf('v = %d fps \n a = %d ft/sec^2',v,a);
```

Scilab code Exa 3.2 Chapter 3 Example 2

```
clear;
```

```
clc;

//page no. 83

v = 5;// fps
a_t = 0;
a_r = v^2 /2;// ft/sec^2
printf('Radial component of acceleration = %.1f ft/
    sec^2\n Tangential component of acceleration = %d
    ',a_r,a_t);
```

Scilab code Exa 3.3 Chapter 3 Example 3

```
clear;
clc;

//page no.85
v = 5;// fps
r = 2;
theta = 60;// degrees
x = 1;
y = sqrt(3);
v_t = v;
v_r = 0;
u = -v*y/(sqrt(x^2 + y^2));
v = v*x/(sqrt(x^2 + y^2));
a_x = -50*x/8;
a_y = -50*y/8;
a_r = -v_t^2 /r;
a_t = v_r*v_t/r;
printf('u = %.2f fps, v = %.2f fps',u,v);
printf('\n v_r = %d, v_t = %d fps',v_r,v_t);
printf('\n a_x = %.2f ft/sec^2, a_y = %.2f ft/sec^2'
    ,a_x,a_y);
printf('\n a_r = %.1f ft/sec^2, a_t = %d',a_r,a_t);
```

Scilab code Exa 3.4 Chapter 3 Example 4

```
clear;
clc;

//page no. 88

w = 600;// pounds
l1 = 12;//inches
l2 = 8;//inches
Q = w/(62.4);
V_12 = Q/(0.25*%pi*(l1/12)^2);
V_8 = Q/(0.25*%pi*(l2/12)^2);
printf('Q = %.2f cfs',Q);
printf('\n V_12 = %.2f fps\n V_8 = %.2f fps',V_12,
    V_8);
```

Scilab code Exa 3.5 Chapter 3 Example 5

```
clear;
clc;

//page no.89

l = 12;// inches
W = 6;// pounds
w = 0.0624// lb/cuft
l1 = 8;// inches
rho = 0.050;// lb/cuft
Q_12 = W/w ;
Q_8 = W/rho ;
```

```
V_12 = Q_12/(0.25*%pi*(1/12)^2);
V_8 = Q_8/(0.25*%pi*(11/12)^2);
printf('Q_12 = %.1f cfs, Q_8 = %d cfs',Q_12,Q_8);
printf('\n V_12 = %.1f fps, V_8 = %d fps',V_12,V_8);

//there is a minute error in the answer given in
   textbook
```

Chapter 4

Flow of an Incompressible Ideal Fluid

Scilab code Exa 4.1 Chapter 4 Example 1

```
clear;
clc;

//page no.103

d = 4;//feet
theta = 30;// degrees
p_C = 5;// psi
p_A = p_C-(62.4/144)*cos(theta*%pi/180) *2;
p_B = p_C+(62.4/144)*cos(theta*%pi/180) *2;
h = p_C*144/62.4;
printf('The static pressures at A and B are %.2f psi
    and %.2f psi respectively.',p_A,p_B);
printf('\n The hydraulic grade line is %.2f ft (
    vertically) above C,',h);
```

Scilab code Exa 4.2 Chapter 4 Example 2

```
clear;
clc;

//page no. 105

h = 100;//ft
d1 = 5;//in
d2 = 8;//in
h1 = 60;// ft
h2 = 10;//ft
h3 = 40;//ft
h4 = 102;//ft
H = 300;//ft
theta = 30;//degrees
gam = 0.43;


V5 = sqrt(h*2*32.2);
Q = V5*0.25*%pi*(d1/12)^2;
V1 = (d1/12)^4 *h;
V2 = h*(d1/d2)^4;
p1 = (h1-V1)*gam;
p2 = -(h2-V2)*2.04*gam;
p3 = (h3-V1)*gam;
p4 = (h4-V1)*gam;
V6 = V5*cos(theta*%pi/180);
e = H - (V6^2)/(2*32.2);
printf('p1 = %.1f psi\n p2 = %.1f in. of Hg vacuum\n
    p3 = %.1f psi\n p4 = %.1f psi',p1,p2,p3,p4);
printf('\n elevation = %.1f ft',e);

//there are small errors in the answer given in
   textbook
```

Scilab code Exa 4.3 Chapter 4 Example 3

```
 clear;
clc;

//page no. 107

p = 14;//psia
gam = 62;//lb/cuft
l1 = 35;// ft
l2 = 10;// ft
d = 6;//in

p_v = 2.2*gam;
p_B = p*144;
k_c = l1-l2+(p_B/gam)-(p_v/gam);
K6 = l1;
d_c = d*(K6/k_c)^0.25;

printf('d = %.2f in',d_c);
```

Scilab code Exa 4.4 Chapter 4 Example 4

```
clear;
clc;

//page no. 108

rho = 0.00238;//slug/cuft
h = 6;//in
V_0 = sqrt(2*(h/12)*(62.4 - rho*32.2)/rho);
```

```
printf('The velocity of the air stream = %d fps',V_0
    );

//there is a small error in the answer given in
    textbook
```

Scilab code Exa 4.5 Chapter 4 Example 5

```
clear;
clc;

//page no.110

sg = 0.82;
p1 = 20;//psia
p2 = 10;//psia
d1 = 6;//in
d2 = 12;//in
del_z = 4;//ft
d = 18.7;//in

h1 = (p1-p2)*144/(sg*62.4) - del_z;
A1 = 0.25*%pi*(d1/12)^2;
A2 = 0.25*%pi*(d2/12)^2;
V2 = sqrt(-2*h1*32.2/(1-(A2/A1)^2));
V1 = (A2/A1)*V2;
Q = A1*V1;
printf('Flow rate = %.2f cfs',Q);

//there is a small error in the answer given in
    textbook
```

Scilab code Exa 4.6 Chapter 4 Example 6

```
clear;
clc;

//page no. 112

e1 = 100;//ft
theta = 60;//degrees
e2 = 98.5;//ft
V_s2 = 20;//fps
e3 = 95;//ft

t2 = (e1-e2)/cos(theta*%pi/180);
p2 = 3*62.4*cos(theta*%pi/180);
V_F2 = sqrt((e1 + (V_s2^2 /(2*32.2)) - p2/62.4 -e2)
    *2*32.2);
q = 3*1*V_s2;
y = 11.22;//ft
y1 = 10.74;//ft
V1 = sqrt((y-y1)*2*32.2);

printf('On spillwy: Pressure = %.1f psf , velocity =
    %d fps' ,p2,V_F2);
printf('\n In the approach channel: Depth = %.2f ft,
    V1 = %.1f fps',y1,V1);
```

Scilab code Exa 4.7 Chapter 4 Example 7

```
clear;
clc;

//page no. 113

d = 10;// in
p = 40;//psi
G = 5;//cfs
```

```
y1 = 92.4;//ft
k1 = -11.3;//ft
k2 = 92.4;//ft
k3 = 3.2;//ft
k4 = 10.1;//ft

E_p = k4+y1+d-k1-k3;
hp = G*62.4*E_p/550;

printf('Pump horsepower = %.1f hp',hp);
```

Scilab code Exa 4.9 Chapter 4 Example 9

```
clear;
clc;

//page no. 122

sw = 20;// specific weight in lb/cuft
p_B = 6;//psi
p_A = 2;//psi
L = 17.28;//ft
l = 10;//ft
V_A = sqrt(2*32.2*((p_B-p_A)*144/50 - l));

printf('The mean velocity = %.2f fps',V_A);
```

Scilab code Exa 4.11 Chapter 4 Example 11

```
clear;
clc;

//page no. 126
```

```
D = 6;//in
v = 100;//fps
p = 0;//psi
gam = 0.08;//specific weight in lb/cuft
R = 6;//in
theta = 60;//degrees
v_r = v*(1-(0.5*D/R)^2)*cos(theta*%pi/180);
v_t = -v*(1+(0.5*D/R)^2)*sin(theta*%pi/180);
V = sqrt(v_r^2 + v_t^2);
p = ((v^2 /(2*32.2)) - (V^2 /(2*32.2)) - (cos(theta*
    %pi/180)*sin(theta*%pi/180)))*gam;
printf('Velocity = %.1f fps\n Pressure = %.2f psf',V
    ,p);

//there is an error in the answer given in textbook
```

Scilab code Exa 4.12 Chapter 4 Example 12

```
clear;
clc;

//page no. 127

p_A = 0;
p_B = 0;
p_C = 0;
p_D = 0;
//velocity heads
V1 = 15.28;//fps
V2 = 16.78;//fps
V3 = 15.50;//fps
V4 = 16.50;//fps

q = sqrt(2*32.2)*integrate('h^(1/2)','h'
```

```
    ,3.771,4.229);

printf('V_A = %.2f fps,\n V_B = %.2f fps,\n V_C = %
    .2f fps,\n V_D = %.2f fps',V1,V2,V3,V4);
printf('\n Flow rate = %.2f cfs/ft',q);
```

Chapter 5

Flow of a Compressible Ideal Fluid

Scilab code Exa 5.1 Chapter 5 Example 1

```
clear;
clc;
//page no. 152

v1 = 100;// fps
p1 = 50;// psia
T1 = 300;// degreeF
v2 = 500;// fps
Cp = 186.5;
gam = 1.4;
T2 = T1 - (v2^2 - v1^2)/(2*36.2*Cp);
p2 = p1*(1 - (v2^2 - v1^2)/(2*36.2*53.3*(T1+460)*(
    gam/(gam-1))))^(1/0.286);
printf('T2 = %d degreeF',T2);
printf('\n p2 = %.1f psia',p2);

//there is an error in the answer given in textbook
```

Scilab code Exa 5.2 Chapter 5 Example 2

```
clear;
clc;

//page no. 153

p1 = 300;// psia
T1 = 900;// degreeF
p2 = 200;// psia
T2 = 780;// degreeF
H2 = 1414;//Btu/lb
H1 = 1471;// Btu/lb
V2 = sqrt(2*31.1*778*(H1-H2));
printf('T2 = %d degreeF\n V2 = %d fps',T2,V2);
```

Scilab code Exa 5.3 Chapter 5 Example 3

```
clear;
clc;

//page no. 155

v = 586;// fps
p = 13;// psia
T = 0;// degreeF
gam = 1.4;
rho_0 = p*144/(32.2*53.3*(460+T));
a_0 = sqrt(gam*32.2*53.3*(T+460));
M_0 = v/a_0;
p_8_approx = p+(0.5/144)*rho_0*v^2 *(1+0.25*M_0^2);
p_8_exact = p*(1+M_0^2 *(gam-1)/2)^(gam/(gam-1));
```

```
T_8 = v^2 /(2*32.2*186.5) +460;
rho_8 = p_8_exact*144/(T_8*32.2*53.3);
printf('At stagnetion point, p = %.2f psia\n T = %.1
    f degreeR\n density = %.5f slug/cuft',p_8_exact,
    T_8,rho_8);
```

Scilab code Exa 5.4 Chapter 5 Example 4

```
clear;
clc;

//page no. 161

d = 1;// in
p = 100;// psi
T = 10;// degreeF
p_i = 80;//psi
p_b = 14.7;//psi
p1 = 16520;// psfa
gam1 = 0.553;// lb/cuft
k = 0.874;
G = (0.5*k*0.25*%pi*(d/12)^2 /(1-(2/3)^4)) *sqrt
    (2*32.2*(p-p_i)*144/gam1);
printf('flow rate = %.2f lb/sec',G);
```

Scilab code Exa 5.5 Chapter 5 Example 5

```
clear;
clc;

//page no. 163
d = 1;// in
p_r = 100;//psi
```

```
T_r = 100;// degreeF
p_b = 14.7;// psi
p3 = 14.7;//psi
G = 2.03;// lb/sec
gam1 = 0.553;
gam = 1.4;
V3 = sqrt(2*32.2*(gam/(gam-1))*(p_r+p_b)*144/gam1
    *(1-(p3/(p_r+p_b))^((gam-1)/gam)));
T3 = (T_r+460) - V3^2 /(2*32.2*186.5);
a3 = sqrt(gam*32.2*53.3*T3);
M3 = V3/a3;
A3 = G/(gam1*V3);
d3 = (A3/(0.25*%pi))^(1/2);
p3_dash = 103.3;// psia
p_B = p3*(1+ (2*gam/(gam+1))*(M3^2 -1));
printf('V3 = %d fps , a3 = %d fps ,  M3 = %.2f ',V3,a3
    ,M3);
printf('\n p3_dash = %.1f psia , p_B = %.1f psia',
    p3_dash,p_B);

//there are minute errors in the answer given in
    textbook
```

Scilab code Exa 5.6 Chapter 5 Example 6

```
clear;
clc;

//page no. 166

V_0 = 586;// fps
t_0 = 0;// degreeF
P_0 = 13;// psia
a_0 = 1052;// fps
M_0 = 0.557;
```

```
V_A = 800;//fps
V_B = 900;//fps
gam = 1.4;
T_A = 488.5- V_A^2 /(2*32.2*186.5);
T_B = 488.5- V_B^2 /(2*32.2*186.5);
p_A = 16.18*(T_A/488.5)^(gam/(gam-1));
p_B = 16.18*(T_B/488.5)^(gam/(gam-1));
a_A = sqrt(gam*32.3*53.3*T_A);
a_B = sqrt(gam*32.3*53.3*T_B);
M_A = V_A/a_A;
M_B = V_B/a_B;
printf('At point A, p = %.2f psia , T = %.1f degreeR ,
    a = %d fps , M = %.3f',p_A,T_A,a_A,M_A);
printf('\n At point B, p = %.2f psia , T = %.1f
    degreeR , a = %d fps , M = %.3f',p_B,T_B,a_B,M_B);

//there are errors in the answers given in textbook
```

Chapter 6

The Impulse Momentum Principle

Scilab code Exa 6.1 Chapter 6 Example 1

```
clear;
clc;

//page no. 176

G = 10;//cfs
d1 = 12;//in
d2 = 8;//in
p1 = 10;//psi
V = 3;//cuft
theta = 60;//degrees
p2 = 3.43;// psi
w = 187;//lb

V1 = G/(0.25*%pi*(d1/12)^2);
V2 = G/(0.25*%pi*(d2/12)^2);
F1 = 0.25*%pi*(d1^2)*p1;
F2 = 0.25*%pi*d2^2 *p2;
Fx = F1+F2*cos(theta*%pi/180) - G*1.935*(-V2*cos(
```

```
theta*%pi/180) - V1);
Fz = F2*sin(theta*%pi/180) + w + G*1.935*(V2*sin(theta*%pi/180));
F = sqrt(Fx^2 + Fz^2);
alpha = (180/%pi)*atan(Fz/Fx);

printf('The force on the bend = %d lb at %d degrees with the horizontal',F,alpha);

//there is a small error in the answer given in textbook
```

Scilab code Exa 6.2 Chapter 6 Example 2

```
clear;
clc;

//page no. 178

l1 = 5;//ft
l2 = 2;//ft

V1 = sqrt(2*32.2*(l2-l1)/(1-(l1/l2)^2));
V2 = (l1/l2)*V1;
q = l1*V1;
F1 = 62.4*(l1^2)/2;
F2 = 62.4*(l2^2)/2;
Fx = F1-F2-q*1.935*(V2-V1);
printf('Force = %d lb and direction is in downstream direction',Fx);

//there is an error in the answer given in textbook
```

Scilab code Exa 6.3 Chapter 6 Example 3

```
clear;
clc;

//page no. 182

d = 2;//ft
Q = 40;//cfs/ft


V1 = Q/d;
y1 = d;
K1 = V1^2 /(32.2*y1);
y2 = (-1 +sqrt(1+8*K1));
V2 = Q/y2 ;
delta = d + (V1^2 /(2*32.2)) - y2 - (V2^2 /(2*32.2))
    ;
hp = Q*62.4*delta/550;
printf('y2 = %.2f ft,\n delta = %.2f ft,\n
    Horsepower dissipated = %.1f hp',y2,delta,hp);

//there are errors in the answer given in textbook
```

Scilab code Exa 6.4 Chapter 6 Example 4

```
clear;
clc;
funcprot(0);
//page no. 184

y1 = 2;//ft
V1 = 20;//fps
beta = 40;//degrees

```

```
K1 = (V1^2)/(32.2*y1);
y2 = (-1 + sqrt(1+8*K1*(sin(beta*%pi/180))^2));
k = (y1/y2)*V1*sin(beta*%pi/180);
del_angle = (180/%pi)*atan(sqrt((tan(beta*%pi/180))
    *(1+2*k^2 /(32.2*y2))/(1+2*K1*(sin(beta*%pi/180))
    ^2)));
theta = beta-del_angle;

printf('The required wedge angle = %d degrees',2*
    theta);

//there is an error in the answer given in textbook
```

Scilab code Exa 6.5 Chapter 6 Example 5

```
clear;
clc;

//page no. 186

p1 = 14.7;//psia
V1 = 1732;//pfs
a1 = 862;//fps

M1 = V1/a1;
M2 = sqrt((1+0.4*0.5*M1^2)/(1.4*M1^2 - 0.4*0.5));
p2 = p1*(1+2*(1.4/2.4)*(M1^2 -1));
V2 = V1*(2+0.4*M1^2)/(2.4*M1^2);
a2 = V2/M2;
T2 = a2^2/(1.4*32.2*53.3);
T1 = a1^2/(1.4*32.2*53.3);
del_T = T2-T1;
printf('p2 = %.1f psia,\n V2 = %d fps,\n a2 = %d fps
    ,\n T2 = %d degreeR',p2,V2,a2,T2);
printf('\n Rise of temperature = %d degreeF',del_T);
```

```
//There are errors in the answer given in textbook
```

Scilab code Exa 6.6 Chapter 6 Example 6

```
clear;
clc;
funcprot(0);

//page no. 188

p1 = 14.7;// psia
v1 = 1732;// fps
a1 = 862;// fps
beta = 40;// degrees


M1 = v1/a1;
T1 = a1^2 /(1.4*32.2*53.3);
p2 = p1*(1 + 2*(1.4/2.4)*(M1^2 *(sin(beta*%pi/180))
    ^2 -1));
theta = beta - (180/%pi)*atan(tan(beta*%pi/180) *
    (0.4*(M1*sin(beta*%pi/180))^2 +2)/(2.4*(M1*sin(
    beta*%pi/180))^2));
M2 = sqrt((1/sin((beta-theta)*%pi/180))^2 *(1 +
    (0.4/2)*((M1*sin(beta*%pi/180))^2) )/(1.4*(M1*sin
    (beta*%pi/180))^2) -(0.4/2));
v2 = v1*cos(beta*%pi/180)/cos((beta-theta)*%pi/180);
a2 = v2/M2;
T2 = a2^2 /(1.4*32.2*53.3);


printf('Angle required = %.1f degrees,\n p2 = %.1f
    psia,\n v2 = %d fps,\n a2 = %d fps,\n T2 = %.1f
    degreeR',theta,p2,v2,a2,T2);
```

```
//there are errors in the answer given in textbook
```

Scilab code Exa 6.7 Chapter 6 Example 7

```
clear;
clc;

//page no. 190

F = 1000;//lb
H = 30000;//ft
v1 = 500;//fps
v2 = 4000;//fps
p2 = 5;//psia
A2 = 1;//sqft
p1 = 4.37;//psia

G_a = (F - (p2-p1)*A2*144)*32.2/(v2-v1);

printf('Ga = %.1f lb/sec',G_a);
```

Scilab code Exa 6.8 Chapter 6 Example 8

```
clear;
clc;

//page no. 194

gam = 0.0765;// lb/cuft
V1 = 293;//fps
hp = 1500;
h = 10;//ft
```

```
V4 = 338;//fps

V = 0.5*(V1+V4);
Q = hp*550/((V4-V1)*V*gam/32.2);
d1 = sqrt(Q/(V1*0.25*%pi));
d4 = sqrt(Q/(V4*0.25*%pi));
F = Q*(gam/32.2)*(V4-V1);
eta = V1/V;

printf('V4 = %d fps,\n V = %.1f fps,\n d1 = %.1f ft
    ,\n d4 = %.2f ft,\n F = %d lb,\n efficiency = %.1
    f percentage',V4,V,d1,d4,F,eta*100);

//there are small errors in the answer given in
    textbook
```

Scilab code Exa 6.9 Chapter 6 Example 9

```
clear;
clc;

//page no. 198

D = 6;//ft
d = 2;//in
V1 = 200;//fps
rpm = 250;
theta = 150;//degrees

u = (rpm/60)*2*%pi*0.5*D;
v1 = V1-u;
v2 = v1;
V_2x = v1*cos(theta*%pi/180) + u;
V_2y = v2*sin(theta*%pi/180);
V2 = sqrt(V_2x^2 + V_2y^2);
```

```
Q = 0.25*%pi*(d/12)^2 *V1;
F_x = Q*1.935*(V_2x-V1);
P = F_x*u/550;

printf('The working component of force on fluid = %d
    lb,\n P = %d hp',F_x,-P);

//thete are small errors in the answers given in
   textbook
```

Scilab code Exa 6.10 Chapter 6 Example 10

```
clear;
clc;

//page no. 199

P = 100;//hp
V = 75;//fps
V1 = 150;//fps
d = 2;//in
alpha1 = 60;//degrees

Q = 0.25*%pi*(d/12)^2 *V1;
F_y = 550*P/V;
V2 = sqrt(V1^2 - P*550/(Q*1.935/2));
alpha2 = (180/%pi)*asin((V1*sin(alpha1*%pi/180) - (
   F_y/(Q*1.935)))/V2);
beta1 = 90 - (180/%pi)*atan((V1*sin(alpha1*%pi/180)
   - V)/(V1*cos(alpha1*%pi/180)));
beta2 = 90 + (180/%pi)*atan((V-V2*sin(alpha2*%pi
   /180))/(V1*cos(alpha1*%pi/180)));

printf('Beta1 = %d degrees,\n Beta2 = %d degrees',
   beta1,beta2);
```

```
//there are small errors in the answer given in
    textbook
```

Scilab code Exa 6.11 Chapter 6 Example 11

```
clear;
clc;

//page no. 203

r1 = 5;//ft
r2 = 3.5;//ft
beta1 = 60;//degrees
beta2 = 150;//degrees
t = 1;//ft
alpha1 = 15;//degree
Q = 333;//cfs
gam = 0.434;

V_r1 = Q/(2*%pi*r1);
V_r2 = Q/(2*%pi*r2);
V_t1 = V_r1*(1/tan(alpha1*%pi/180));
u1 = V_t1 - V_r1*tan((90-beta1)*%pi/180);
omega = u1/r1;
u2 = omega*r2;
V_t2 = u2 - V_r2*(1/tan((90-beta1)*%pi/180));
T = Q*1.935*(V_t1*r1 - (V_t2*r2));
hp = T*omega/550;
E_T = hp*550/(Q*62.4);
V1 = sqrt(V_r1^2 + V_t1^2);
V2 = sqrt(V_r2^2 + V_t2^2);
del_p = E_T*gam + (gam/(2*32.2))*(V2^2 - V1^2);

```

```
printf('V1 = %.1f fps,\n V2 = %.1f fps,\n T = %d ft-lb,\n hp = %d lb,\n E_T = %.1f ft-lb/lb,\n p1-p2 = %.1f psi',V1,V2,T,hp,E_T,del_p);

//there are small errors in the answer given in textbook
```

Scilab code Exa 6.12 Chapter 6 Example 12

```
clear;
clc;

//page no. 204

r1 = 3;//in
r2 = 10;//in
beta1 = 120;//degrees
beta2 = 135;//degrees
t = 1;//in
Q = 4;//cfs
gam = 0.434;


V1 = Q*144/(2*%pi*r1);
V_r1 = V1;
V_r2 = Q*144/(2*%pi*r2);
u1 = V1*tan((beta1-90)*%pi/180);
omega = u1/(r1/12);
u2 = omega*(r2/12);
V_t2 = u2 - V_r2/tan((180-beta2)*%pi/180);
T = Q*1.935*(V_t2*(r2/12));
P = T*omega/547.561;//hp
E_P = P*550/(Q*62.4);
V2 = sqrt(V_r2^2 + V_t2^2);
del_p = E_P*gam + (gam/(2*32.2))*(V1^2 - V2^2);
```

```
printf('Rotational speed = %.1f rad/sec = %d rpm',
    omega,omega*60/(2*%pi));
printf('\n T = %d ft-lb,\n P = %.1f hp',T,P);
printf('\n The energy given to each pound of water =
     %d ft',E_P);
printf('\n The pressure rise = %.1f psi',del_p);

//there are small errors in the answer given in
    textbook
```

Chapter 7

Flow of a Real Fluid

Scilab code Exa 7.1 Chapter 7 Example 1

```
clear;
clc;

//page no. 225

nu = 0.00001;// sqft/sec
d = 1;//in
R_c = 2100;
V = R_c*nu/(d/12);
Q = V*0.25*%pi*(d/12)^2;
printf('Q = %.6f cfs',Q);
```

Scilab code Exa 7.4 Chapter 7 Example 4

```
clear;
clc;

//page no. 240
```

```
G = 240;//lb/sec
A1 = 4;//sqft
A2 = 2;//sqft
z1 = 30;//ft
z2 = 80;//ft
V1 = 600;// fps
V2 = 800;//fps
p1 = 20;//psia
p2 = 35;// psia
gam1 = G/(A1*V1);
gam2 = G/(A2*V2);
T1 = p1*144/(53.3*gam1);
T2 = p2*144/(53.3*gam2);
del_H = 186.5*(T2-T1);
E_H1 = (V2^2)/(2*32.2) - (V1^2)/(2*32.2) +del_H+z2-
    z1;
E_H2 = (V2^2)/(2*32.2) - (V1^2)/(2*32.2) +del_H;
Q = G*E_H2/550;
printf('T1 = %d degreeR,\n T2 = %d degreeR',T1,T2);
printf('\n The net heat energy added = %d hp',Q);

//there is an error in the answer given in textbook
```

Scilab code Exa 7.5 Chapter 7 Example 5

```
clear;
clc;

//page no. 240

G = 50;//cfs
Q = 400;//hp
A1 = 4;//sqft
A2 = 2;//sqft
```

```
z1 = 30;//ft
z2 = 80;//ft
p1 = 20;//psi
p2 = 10;//psi

V1 = G/A1;
V2 = G/A2;
E_p = Q*(550/62.4)/G;
h_L = (p1-p2)*144/62.4 + (V1^2 - V2^2)/(2*32.2) +(z1
    -z2)+E_p;
printf('Head lost = %.1f ft',h_L);
```

Scilab code Exa 7.6 Chapter 7 Example 6

```
clear;
clc;

//page no. 243

b = 3;//ft
d = 2;//ft
l = 200;//ft
h_L = 30;//ft
tau_0 = h_L*62.4*b*d/(10*l);//0.00694
printf('The resistance stress exerted between fluid
    and conduit walls = %.2f psf = %.3f psi',tau_0,
    tau_0*0.00694);
```

Scilab code Exa 7.7 Chapter 7 Example 7

```
clear;
clc;

```

```
//page no.244

h_L = 30;//ft
l = 200;//ft
d = 2;//ft
r = 8;//in
//part (a)
tau_0 = h_L*62.4/(d*l);

//part(b)
tau = (0.5*r/12)*(tau_0*0.00694);
printf('Part(a): Shear stress = %.2f psf = %.4f psi
    ',tau_0,tau_0*0.00694);
printf('\n Part(b): Shear stress = %.4f psi ',tau);
```

Chapter 8

Similitude and Dimensional Analysis

Scilab code Exa 8.1 Chapter 8 Example 1

```
clear;
clc;
//page no. 266

Tw = 32;// degreeF
d1 = 3;// in
v = 10;//fps
delp = 2;//psi
h1 = 30;// ft
Tb = 68;//degreeF
d2 = 1;//in
h2 = 10;//ft
V = v*(d1/12)*0.0000137/((d2/12)*0.88*0.0000375);
del_p = delp/h2^2 *0.88*V^2;
printf('V = %.2f fps\n del_p = %.2f psi',V,del_p);
```

Scilab code Exa 8.2 Chapter 8 Example 2

```
clear;
clc;

//page no. 266

l = 400;// ft
h = 10;//ft
v = 30;// fps
D = 2;//lb
V = sqrt((v^2 /l)*h);
D_p = (D/V^2) *(v^2)*(l^2)/h^2;
printf('V = %.2f fps\n Prototype drag = %d lb',V,D_p
    );
```

Scilab code Exa 8.3 Chapter 8 Example 3

```
clear;
clc;

//page no.266

G = 20000;//cfs
k = 1/15;
Q_m = G*(k)^(2+ 1/2);
printf('Q_m = %d cfs',Q_m);

//there is a minute error in the answer given in
    textbook
```

Scilab code Exa 8.4 Chapter 8 Example 4

```
clear;
clc;

//page no. 266

k = 1/10;
v = 3000;//fps
h = 15000;//altitude
T = 68;// degreeF
am = 870;//fps
ap = 1057;//fps
Vm = v*(am/ap);
rho_m = v*(1/k)*0.001495*0.031/(0.033*Vm);
p_m = 32.2*rho_m*34.9*(T+460)/(144);
printf('Vm = %d fps\n p_m = %d psia',Vm,p_m);

//there is a small error in the answer given in
   textbook
```

Chapter 9

Fluid Flow in Pipes

Scilab code Exa 9.1 Chapter 9 Example 1

```
clear;
clc;

//page no.281
d = 6;//inches
v = 15;//fps
l = 100;//ft
h_L = 17.5;//ft
f = h_L*(d/(12*l))*(2*32.2/v^2);
V_f = v*sqrt(f/8);
printf('The friction velocity = %.2f fps',V_f);

//there is an error in the answer given in textbook
```

Scilab code Exa 9.2 Chapter 9 Example 2

```
clear;
clc;
```

```

//page no. 285

T = 100;// degreeF
d = 3;// inches
Re = 80000;// Reynolds number
e = 0.006;// inches
l = 1000;//feet
f1 = 0.021;//friction factor
nu = 0.729*10^-5;// sqft/sec
V = Re*nu/0.25;
h_L1 = f1*(l/0.25)*(V^2 /(2*32.2));
f = 0.316/Re^0.25;
h_L = (f/f1)*h_L1;
printf('Head loss expected = %.1f ft\n and head loss expected if the pipe were smooth = %.2f ft',h_L1,h_L);
```

Scilab code Exa 9.3 Chapter 9 Example 3

```
clear;
clc;

//page no. 288

T = 100;//degreeF
d = 3;// inches
Re = 80000;// Reynolds number
e = 0.006;//inches
l = 1000;//ft
f = 0.0255;//friction factor
V = 2.33;//fps
h_L = f*(l/0.25)*(V^2 /(2*32.2));
printf('Head loss expected = %.1f ft',h_L);
```

Scilab code Exa 9.4 Chapter 9 Example 4

```
clear;
clc;

//page no. 290

Q = 100;//gallons per minute
sg = 0.90;
nu = 0.0012;// lb-sec/sqft
d = 3;// in
l = 1000;//ft
r = 1;//in
V = 4.53;//fps
Re = V*(d/12)*sg*1.935/nu;
h_L = (64/Re)*(12*l/d)*(V^2 /(2*32.2));
v = 2*V*(1 - (2/d)^2);
tau = 62.4*sg*h_L/(2*l*12);
printf('v = %.2f fps\n h_L = %.1f ft of oil\n tau =
    %.3f psf',v,h_L,tau);
```

Scilab code Exa 9.6 Chapter 9 Example 6

```
clear;
clc;

//page no. 295

Q = 90;// gallons per minute
T = 68;//degreeF
d = 3;// in
l = 3000;//ft
```

```
r = 1;// in
f = 0.018;
V = Q/(60*7.48*0.25*%pi*(d/12)^2);
Re = V*(d/12)*1.935/(0.000021);
h_L = f*(1/0.25)*(V^2 /(2*32.2));
tau_0 = f*1.935*V^2 /8;
tau1 = 2*tau_0/d;
v_c = V*(1+4.07*sqrt(f/8));
v_ = sqrt(tau_0/1.935);
v1 = v_*(5.50+5.75*log10(v_*(r/(2*12))/0.00001085));
v1_ = v_c-v_*5.75*log10(0.5*d/(r/2));
delta = d*32.8/(Re*sqrt(f));
printf('Head lost = %.1f ft of water\n Wall shear
    stress = %.3f psf\n the center velocity = %.2f
    fps\n shearing stress = %.3f psf\n v1 = %.2f fps\
    n delta = %.4f in.',h_L,tau_0,v_c,tau1,v1_,delta)
    ;
```

Scilab code Exa 9.7 Chapter 9 Example 7

```
clear;
clc;

//page no. 298

d = 12;// in
v = 10;//fps
e = 2;//in
k = 0.002;//relative roughness
l = 1000;//ft
f = (1/(1.14+2*log10(1/k)))^2;
v_c = v*(1+4.07*sqrt(f/8));
tau_0 = f*1.935*v^2 /8;
v2 = v_c - tau_0*5.75*log10(0.5*d/e);
v2_ = 8.48*tau_0 + tau_0*5.75*log10(e/(12*k));
```

```
h_L = f*(l)*v^2 /(2*32.2);
printf('f = %.4f\n v_c = %.2f fps\n v2 = %.1f fps\n
    h_L = %.1f ft of water',f,v_c,v2_,h_L);

//there are small errors in the answer given in
    textbook
```

Scilab code Exa 9.8 Chapter 9 Example 8

```
clear;
clc;

//page no. 300

V = 4.08;// fps
Re = 93800;//Reynolds number
r = 1;//in
m = 1/7;
R = 3;//in
f = 0.316/(Re^0.25);
v_c = V/(2/((m+1)*(m+2)));
v1 = v_c*(r/R)^(1/7);
tau_0 = f*1.935*V^2 /8;
printf('f = %.3f\n v_c = %.2f fps\n v1 = %.2f fps\n
    wall shear = %.3f ps',f,v_c,v1,tau_0);
```

Scilab code Exa 9.9 Chapter 9 Example 9

```
clear;
clc;

//page no. 302

```

```
p = 14.7;//psia
T = 60;// degreeF
l = 2000;//ft
b = 18;//in
h = 12;// in
v = 10;// fps
R_h = (b*h)/(2*12*(b+h));
Re = v*4*R_h*0.0763/(32.2*0.000000375);
f = 0.019;
h_L = f*(l/(4*R_h))*v^2 /(2*32.2);
del_p = 0.0763*h_L;
printf('loss of head = %.1f ft of air\n and the
    pressure drop = %.2f psf = %.3f psi',h_L,del_p,
    del_p*0.0069);
```

Scilab code Exa 9.10 Chapter 9 Example 10

```
clear;
clc;

//page no. 305
Q = 90;//gpm
d = 3;//in
l = 3000;//ft
V = Q/(60*7.48*0.25*%pi*(d/12)^2);
R_h = (d/12)/4;
C_hw = 140;
S = (V/(1.318*140*R_h^0.63))^(1/0.54);
h_L = S*l;
printf('The loss of head = %.1f ft of water',h_L);

//there is a minute error in the answer given in
    textbook
```

Scilab code Exa 9.11 Chapter 9 Example 11

```
clear;
clc;

//page no. 307

G = 40;// lb/min
d = 3;// in
T = 100;// degreeF
p = 50;// psia
l = 2000;//ft
Re = ((G/60)*(d/12))/(0.0491*32.2*4*10^-7);
f = 0.015;
gam1 = p*(144/(53.3*(T+460)));
V1 = (G/60)/(gam1*0.0491);
a = sqrt(1.4*32.2*53.3*(T+460));
M1 = V1/a;
M2_limit = sqrt(1/1.4);
l = (((1-(M1/M2_limit)^2)/(1.4*M1^2)) - 2*log(
    M2_limit/M1))*(0.25/0.015);
p2 = 38.9;//psia, from trial and error method
printf('p2 = %.1f psia',p2);
```

Scilab code Exa 9.12 Chapter 9 Example 12

```
clear;
clc;

//page no. 312

d = 12;// in
```

```
D = 24;//in
theta = 20;//degrees
G = 10;//cfs
p = 20;//psi
V12 = G/(0.25*%pi);
V24 = V12/4;
K_L = 0.43;
p24 = ((p*144/62.4) + (V12^2 /(2*32.2)) - ((V24^2)
    /(2*32.2)) - K_L*(V12-V24)^2 /(2*32.2))/2.314;
printf('Pressure in the larger pipe = %.1f psi',p24)
    ;
```

Scilab code Exa 9.13 Chapter 9 Example 13

```
clear;
clc;

//page no. 322

d = 12;// in
l = 1000;//ft
h1 = 200;//elevation
h2 = 250;//elevation
T = 50;//degreeF
f1 = 0.030;
V1 = sqrt((h2-h1)*2*32.2/(0.5+f1*l +1));
R1 = V1/0.00000141;
f2 = 0.019;
V2 = sqrt((h2-h1)*2*32.2/(0.5+f2*l +1));
R2 = V1/0.00000141;
Q = 0.25*%pi*(d/12)^2 *V2;
printf('Velocity = %.1f fps\n flow rate = %.1f cfs',
    V2,Q);
```

Scilab code Exa 9.14 Chapter 9 Example 14

```
clear;
clc;

//page no. 322

l = 200;//ft
Q = 0.1;//cfs
del_h = 5;//ft
T = 50;//degreeF
d = 0.187;//ft
V = Q/(0.25*%pi*d^2);
R = V*d/0.0000141;
f = (del_h*2*32.2/V^2 -(1+0.5))*(d/l);
printf('Required diameter of the pipe = %.2f in.',d
    *12);
```

Scilab code Exa 9.15 Chapter 9 Example 15

```
clear;
clc;

//page no. 324

Q = 2.5;//cfs
T = 50;//degreeF
d1 = 8;//in
d2 = 6;//in
l1 = 1000;//ft
l2 = 2000;//ft
V8 = Q/(0.25*%pi*(d1/12)^2);
```

```
V6 = Q/(0.25*%pi*(d2/12)^2);
R8 = V8*0.667/0.0000141;
f8 = 0.020;
R6 = V6*0.5/0.0000141;
f6 = 0.019;
h_L8 = f8*(l1/0.667)*(V8^2 /(2*32.2));
h_L6 = f6*(l2/0.5)*(V6^2 /(2*32.2));
Ep = 100+h_L8+h_L6;
n = Q*62.4*(Ep)/550;
V8 = sqrt((30/f8)*2*32.2/(l1/0.667));
Q_max = V8*0.25*%pi*(d1/12)^2;
printf('Maximum reliable flow that can be pumped = %
    .1f cfs',Q_max);
```

Scilab code Exa 9.16 Chapter 9 Example 16

```
clear;
clc;

//page no. 327

Q = 5;//cfs
d = 12;//in
l = 5000;//ft
h = 70;//ft
L = 2000;//ft
K = (h/Q^1.85);
a = (L/l)*K;
b = ((l-L)/l)*K;
Q_ = (h/((b+a*(0.5^(1.85)))))^(1/1.85);
Q_A = Q_/2;
Q_B = Q_/2;
del = Q_-Q;//gain capcaity
percent = (del/Q)*100;//gain percentage
printf('The gain of capacity by looping the pipe is
```

```
%.1f cfs or %d percentage',del,percent);
```

Chapter 11

Fluid Measurements

Scilab code Exa 11.1 Chapter 11 Example 1

```
clear;
clc;

//page no.409

C_I = 0.98;//coefficient of pitot tube
d = 3;//in

del_p = (d/12)*(13.55-0.88)/0.88;
v_c = C_I*sqrt(2*32.2*del_p);

printf('The velocity at the centerline of the pipe =
    %.1f fps',v_c);
```

Scilab code Exa 11.2 Chapter 11 Example 2

```
clear;
clc;
```

```

//page no. 411

P = 25;//in. of mercury
p = 18;//in. of mercury
T = 150;//degreeF

k = P/p;
if k < (1.893) then
    V = sqrt(2*32.2*186.5*(T+460)*(1-(1/k)^0.286));
end

printf('The local velocity just upstream from the
    pitot static tube = %d fps',V);
```

Scilab code Exa 11.3 Chapter 11 Example 3

```
clear;
clc;

//page no. 411

P = 20;//in. of mercury
p = 5;//in. of mercury
T = 150;//degreeF

k = P/p;

if k >1.893 then
    M_0 = 1.645;
end
V_0 = sqrt(2*32.2*186.5*(T+460)/(1+ (2*186.5)
    /(53.3*1.4*M_0^2)));

printf('The speed of this airplane = %d fps',V_0);
```

```

//there is an error in the answer given in textbook
```

Scilab code Exa 11.4 Chapter 11 Example 4

```
clear;
clc;

//page no. 420

b = 6;//in
d = 3;//in
p = 20;//psi
del_p = 6;//in. of mercury
p_bar = 14.70;//psia
T = 60;//degreeF

k = (p + p_bar - b*(p_bar/29.92))/(p+p_bar);
gam1 = (p+p_bar)*144/53.3 /(T+460);
A2 = 0.0491;//sqft
Y = 0.949;
Cv = 0.98;
G = Y*Cv*A2*gam1*sqrt(2*32.2*b*10*A2*144/gam1) /(
    sqrt(1-0.25^2));
Cv_true = 0.981;
G_true = G*Cv_true/Cv;

printf('G = %.2f lb/sec',G);
```

Scilab code Exa 11.5 Chapter 11 Example 5

```
clear;
clc;
```

```
//page no. 422

d = 3;//in
l = 6;//in
h = 6;//in
T = 60;//degreeF

Cv= 0.99;
A1 = 0.25*%pi*(d/12)^2;
Q = Cv*A1*sqrt(2*32.2*(h/12)*(13.55-1)) /(sqrt
    (1-0.25^2));
Cv_true = 0.988;
Q_true = Q*Cv_true/Cv;
h_L = 3.8;

printf('Q = %.3f cfs',Q);
printf('\n True Q = %.3f cfs',Q_true);
printf('\n Total head loss is about %.1f ft of water
    ',h_L);

//there are small errors in the answer given in
    textbook
```

Chapter 12

Elementary Hydrodynamics

Scilab code Exa 12.2 Chapter 12 Example 2

```
clear;
clc;

//page no. 491

Q = 0.00010;//cfs
t = 0.1;//ft
h = 3;//ft
d = 6;//in

K = Q*h/(t*0.25*%pi*(d/12)^2);

printf('K = %.5f fps',K);

//there is an error in the answer given in textbook
```

Chapter 13

Fluid Flow about Immersed Objects

Scilab code Exa 13.1 Chapter 13 Example 1

```
clear;
clc;

//page no. 502

b = 50;//ft
c = 7;//ft
CL = 0.6;//lift coefficient
CD = 0.05;//drag coefficient
alpha = 7;//degrees
V = 150/0.681818;//coverting mph to fps
H = 10000;//ft
rho = 0.001756;//slug/cuft

D = CD*b*c*rho*0.5*V^2;
hp = D*V/550;
L = CL*b*c*rho*0.5*V^2;
mu = 3.534*10^-7;//lb-sec/sqft
R = V*c*rho/mu;
```

```
a = sqrt(1.4*33.2*53.3*(23.4+459.6));
M = V/a;

printf('hp = %d hp,\n L = %.2f lb,\n R = %d,\n M = %
    .3f',hp,L,R,M);

//there are small errors in the answer given in
    textbook
```

Scilab code Exa 13.2 Chapter 13 Example 2

```
clear;
clc;

//page no. 511

l = 5;//ft
d = 0.5;//ft
v = 1;//fps
T = 60;//degreeF
D = 0.04;//lb
k = 1/64;//model scale

nu = 0.00001217;
R = v*l/nu;
Cf1 = 0.0020;
Cf2 = 0.0052;
Dx1 = 2*Cf1*l*d*1.938*0.5*v^2;
Dx2 = 2*Cf2*l*d*1.938*0.5*v^2;
delta1 = l*5.20/sqrt(R);
delta2 = l*0.38/(R^0.2);
V_0 = sqrt((v^2 /l)*(l*(1/k)));
R_p = V_0*l*(1/k)/nu;
Cf = 0.00185;
Dx = 2*Cf*l*d*(1/k)^2 *1.938*0.5*V_0^2;
```

```
Dw = D-Dx2;
Dw_p = (1/k)^2 *d*l*V_0^2 *Dw/(l*d);
D = Dw_p + Dx;

printf('Total drag of the prototype = %d lb',D);

//there is an error in the answer given in textbbok
```

Scilab code Exa 13.3 Chapter 13 Example 3

```
clear;
clc;

//page no. 524

c = 6;//ft
b = 36;//ft
AR1 = 6;//aspect ratio
Cd = 0.0543;//drag coefficient
Cl = 0.960;//lift coefficient
alpha1 = 7.2;//degrees
AR2 = 8;

//for aspect ratio = 8
CL = 0.960;//negligible change of lift coefficient
//for aspect ratio = 6
C_Di = Cl^2 /(%pi*AR1);
//for aspect ratio = infinity
C_D0 = Cd - C_Di;
//for AR = 8
C_D = C_D0 + Cl^2 /(%pi*AR2);
//for AR = 6
alpha_i = (180/%pi)*Cl/(%pi*AR1);
//for AR = infinty
alpha_0 = alpha1 - alpha_i;
```

```
//for AR = 8
alpha = alpha_0 + Cl/(AR2*%pi) *(360/(2*%pi));

printf('Lift coefficient = %.3f (negligible change
   of lift coefficient)',CL);
printf('\n Drag coefficient = %.4f',C_D);
printf('\n Angle of attack = %.1f degress',alpha);
```