Scilab Textbook Companion for Mechanical Engineering Thermodynamics by D. A. Mooney[1]

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Book Description

Title: Mechanical Engineering Thermodynamics

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

Contents

List of Scilab Codes

Chapter 2

Work

Scilab code Exa 2.1 example 1

```
clc
//Initialization of variables
g=1.4
P=100 //psia
V1=3 //cu ft
Pf=20 //psia
//calculations
V2=V1*(P/Pf)^(1/g)
W=(Pf*V2-P*V1)*144/(1-g)
//results
printf("Net work done = %d ft",W)
```

Scilab code Exa 2.2 example 2

```
clc
//Initialization of variables
Wb=-33000 //ft-lb
V2=3 //cu ft
```

```
V1=1 //cu ft
P=69.4 //psia
//calculations
Wa=P*(V2-V1)*144
W=Wa+Wb
//results
printf("Net work done = %d ft-lb",W)
```

Scilab code Exa 2.3 example 3

```
clc
//Initialization of variables
b=11 //in
s=15 //in
l=2.4 //in
k=80 //psi per in
//calculations
a=%pi*b^2 /4
L=s/12
Pm=1.6/l *k
W=Pm*a*L
//results
printf("Net work done = %d ft lb",W)
```

Chapter 3

Temperature and Heat

Scilab code Exa 3.1 example 1

```
clc
//Initialization of variables
T1=500 //F
T2=100 //F
Tf=75 //F
cpi=0.120 //B/lb F
cpw=1.0 //B/lb F
//calculations
Qw=1*cpw*(T2-Tf)
Qi=-1*cpi*(T2-T1)
mw=Qi/Qw
//results
printf("Mass of water = %.2f lb water/lb iron",mw)
```

Scilab code Exa 3.2 example 2

```
clc
//Initialization of variables
```

```
m=5 //lb
T1=1540+460  //R
T2=540+460  //R
//calculations
function [cp]=q(T)
    cp=m*(0.248+0.448*10^-8 *T^2)
endfunction
Q=intg(T1,T2,q)
//results
printf("Heat transferred = %d Btu",Q)
```

Scilab code Exa 3.3 example 3

```
clc
//Initialization of variables
Tm=235 //F
Tb=832 //F
T=70 //F
cps=0.18 //B/lb F
cpl=0.235 //B/lb F
Lf=15.8 //B/lb
Lv=120 //B/lb
m=10 //lb
//calculations
Qa=m*cps*(Tm-T)
Qb=m*Lf
Qc=m*cpl*(Tb-Tm)
Qd=m*Lv
Q=Qa+Qb+Qc+Qd
//results
printf("Heat required = %d Btu",Q)
```

Scilab code Exa 3.4 example 4

```
clc
//Initialization of variables
T1=22 //F
T2=32 //F
T3=40 //F
T4=70 //F
cps=0.501 //B/lb F
cpw=1 //B/lb F
Lf=143.3 //B/lb
m=40 //lb
//calculations
Qa=cps*(T2-T1)
Qb=Lf
Qc=cpw*(T3-T2)
Qd=m*cpw*(T3-T4)
mi=-Qd/(Qa+Qb+Qc)
//results
printf("Mass of ice required  = %.2f lb ice",mi)
```

Scilab code Exa 3.5 example 5

```
clc
//Initialization of variables
T1=22 //F
T2=32 //F
T3=40 //F
T4=70 //F
cps=0.501 //B/lb F
cpw=1 //B/lb F
Lf=143.3 //B/lb
m=40 //lb
cp=0.092
mc=10
//calculations
Qa=cps*(T2-T1)
```

```
Qb=Lf
Qc=cpw*(T3-T2)
Qe=mc*cp*(T3-T4)
mi=-Qe/(Qa+Qb+Qc)
//results
printf("Extra Mass of ice required  = %.3f lb ice",
   mi)
```

Chapter 5

The first law of thermodynamics

Scilab code Exa 5.1 example 1

```
clc
//initialization of varaibles
V1=10 //cu ft
P1=15 //psia
V2=5 //cu ft
H=34.7 //Btu
//calculations
W=P1*(V2-V1)*144
dE=-H-W/778
//results
printf("Internal energy change = %.1f Btu",dE)
```

Scilab code Exa 5.2 example 2

```
clc
//initialization of varaibles
```

```
dT=35 //F
H=34 //Btu
cv=1.2 //B/lb F
m= 2 //lb
//calculations
U=cv*dT*m
W=H-U
//results
printf("Work done = %d Btu",W)
printf("\n Internal energy change = %.1f Btu",U)
```

Scilab code Exa 5.3 example 3

```
clc
//initialization of varaibles
p=500 //psia
V2=0.9278 //cu ft
V1=0.0197 //cu ft
h2=1204.4 //B/lb
h1=449.4 //B/lb
//calculations
W=p*(V2-V1)*144
du=h2-h1-144*p*(V2-V1)/778
du2=h2-h1-W/778
//results
printf("Change in internal energy = %.1f Btu",du)
printf("\n Method 2, Internal energy change = %.1f
   Btu",du2)
```

Scilab code Exa 5.4.a example 4

```
clc
//initialization of varaibles
```

```
P1=75 //psia
P2=15 //psia
V1=6 //cu ft
g=1.2
m=3
//calculations
V2=V1*(P1/P2)^(1/g)
U=0.48*(P2*V2-P1*V1)
W=(P2*V2-P1*V1)*144/((1-g)*778)
Q=U+W
//results
printf("Heat = %.3f Btu",Q)
//The answer given in textbook is wrong. please check using a calculator
```

Scilab code Exa 5.4.b example 5

```
clc
//initialization of varaibles
P1=75 //psia
P2=15 //psia
V1=6 //cu ft
g=1.2
m=3
//calculations
Q=30 //Btu
V2=V1*(P1/P2)^(1/g)
U=0.48*(P2*V2-P1*V1)
W=Q-U
//results
printf("Work done = %.1f  Btu",W)
//The answer given in textbook is wrong. please check using a calculator
```

Chapter 6

Flow Procesess First law analysis

Scilab code Exa 6.1 example 1

```
clc
//initialization of varaibles
u1=1111.9 //Btu/lb
P1=170 //psia
v1=2.675 //cu ft/lb
v2=100.9 //cu ft/lb
z1=10 //ft
V1=6000/60 //ft/sec
Q=-1000
u2=914.6 //B/lb
P2=3 //psia
V2=300 //ft/sec
rate=2500  //lb/hr
//calculations
Wx=rate*(u1-u2 + (P1*v1-P2*v2)*144/778 +(V1^2 -V2^2)
   /(2*32.2*778) +z1/778 +Q/rate)
f=3.92*10^-4
//results
printf("Power output of turbine = %d B/hr",Wx)
```

```
printf("\n Power output in hp = %d hp",Wx*f+1)
```

Scilab code Exa 6.2 example 2

```
clc
//initialization of varaibles
w1=500                  //lb/min
h1=132.9                //lb/min
h2=1150                 //B/lb
h3=180                  //B/lb
//calculations
w2=(w1*h1-w1*h3)/(h3-h2)
//results
printf("Flow rate = %.1f lb/min",w2)
```

Scilab code Exa 6.3 example 3

```
clc
//initialization of varaibles
v2=5.434            //cu ft/lb
v1=4.937            //cu ft/lb
h1=1227.6
h2=1223.9
A1=%pi/144
//calculations
Vratio=v2/v1
V1=sqrt(64.4*(h1-h2)*778/(Vratio^2 -1))
V2=V1*Vratio
w=A1*V1/v1
//results
printf("Average velocity at 1 = %d fps",V1)
printf("\n Average velocity at 2 = %d fps",V2)
printf("\n Rate of flow = %.2f lb/sec",w)
```

Chapter 8

Basic applications of the second law

Scilab code Exa 8.1 example 1

```
clc
//initialization of varaibles
T1=85+460 //R
T2=50+460 //R
//calculations
eta=(T1-T2)/T1
//results
printf("Max. efficiency = %.1f percent",eta*100)
```

Scilab code Exa 8.2 example 2

```
clc
//initialization of varaibles
T1=1050+460//R
T2=90+460 //R
//calculations
```

```
eta=(T1-T2)/T1
//results
printf("Max. possible efficiency = %d percent",eta
   *100)
```

Scilab code Exa 8.3 example 3

```
clc
//initialization of varaibles
T1=50+460 //R
T2=150+460 //R
m=1
cp=0.240
//calculations
ds=m*cp*(log(T2) - log(T1))
//results
printf("Change in entropy = %.4f B/ F abs",ds)
```

Scilab code Exa 8.4 example 4

```
clc
//initialization of varaibles
T1=50+460 //R
T2=150+460 //R
m=1
cp=0.240
//calculations
ds=m*cp*(log(T2) - log(T1))
//results
printf("Change in entropy = %.4f B/ F abs",ds)
```

Scilab code Exa 8.5 example 5

```
clc
//initialization of varaibles
Q=826 //B/lb
T=860 //R
T1=2000+460 //R
T2=1000+460 //R
//calculations
ds=Q/T
dsgas=Q*(log(T2)-log(T1))/(T1-T2)
dst=ds+dsgas
//results
printf("Total entropy change = %.3f B/R",dst)
```

Scilab code Exa 8.6 example 6

```
clc
//initialization of varaibles
T0=540 //R
Q=826 //B/lb
ds=0.534
ds2=0.431
//calculations
tds=T0*ds
tds2=T0*ds2
H=Q-tds2
Loss=tds/H
//results
printf("Loss = %d percent",Loss*100+1)
```

Chapter 10

Tabulated properties Steam Tables

Scilab code Exa 10.1 example 1

```
clc
//initialization of varaibles
P=100 //psia
hfg=888.8 //B/lb
//calculations
disp("From steam tables,")
vg=4.432 //cu ft/lb
vf=0.001774 //cu ft/lb
W=P*(vg-vf)*144
ufg=807.1 //B/lb
W=hfg-ufg
sfg=1.1286
Q=788*sfg
//results
printf("Work done = %.1f B/lb",W)
printf("\n Heat of vaporization of water = %d B/lb",
   Q)
```

Scilab code Exa 10.2 example 2

```
clc
//initialization of varaibles
s=1.6315 //B/lb R
//calculations
disp("From table 1 ")
h=1180.6 //B/lb
t=302.92 //F
p=70 //psia
//results
printf("Pressure = %d psia",p)
printf("\n Temperature = %.2f F",t)
printf("\n Enthalpy = %.1f B/lb",h)
```

Scilab code Exa 10.3 example 3

```
clc
//initialization of varaibles
T=250 //F
disp("From table 1,")
p=29.825 //psia
hg=1164 //B/lb
vg=13.821 //cu ft/lb
//calculations
ug=hg-(p)*144*vg/778
//results
printf("Internal energy of the gas = %.1f B/lb",ug)
```

Scilab code Exa 10.4 example 4

```
clc
//initialization of varaibles
x=0.4
P=100 //psia
//calculations
y=1-x
disp("From table 2,")
vf=0.01774
vg=4.432
vx=x*vf+y*vg
hf=298.4
hfg=888.8
hx=hf+y*hfg
sg=1.6026
sfg=1.1286
sx=sg-x*sfg
//results
printf("Specific volume = %.3f cu ft/lb",vx)
printf("\n Enthalpy = %.1f B/lb",hx)
printf("\n Entropy = %.4f B/lb R",sx)
```

Scilab code Exa 10.5 example 5

```
clc
//initialization of varaibles
x=0.97
P=100 //psia
//calculations
disp("From table 2,")
hf=298.4
hfg=888.8
hx=hf+x*hfg
hg=1187.2
```

```
hx2=hg-(1-x)*hfg
//results
printf("Accurate Enthalpy = %.1f B/lb",hx2)
printf("\n Enthalpy = %d B/lb")
```

Scilab code Exa 10.6 example 6

```
clc
//initialization of varaibles
s=1.7050 //B/lb R
//calculations
disp("From table 2,")
sx=1.7050
sg=1.7549
sfg=1.4415
dx=(sg-sx)/sfg
hg=1150.8
hfg=969.7
hx=hg-dx*hfg
vg=26.29
vfg=26.27
vx=vg-dx*vfg
//results
printf("Specific volume = %.3f cu ft/lb",vx)
printf("\n Enthalpy = %.1f B/lb",hx)
```

Scilab code Exa 10.7 example 7

```
clc
//initialization of varaibles
P=150 //psia
T=400 //F
//calculations
```

```
disp("From table 3,")
h=1219.4 //B/lb
//results
printf("Enthalpy = %.1f B/lb",h)
```

Scilab code Exa 10.8 example 8

```
clc
//initialization of varaibles
en=1303.7 //B/lb
P=300 //psia
//calculations
disp("Given hg is less than h, steam is superheated.
    T=580 F")
T=580 //F
//results
printf("Temperature = %d F",T)
```

Scilab code Exa 10.10 example 10

```
clc
//initialization of varaibles
T=100 //F
P=1000 //psia
//calculations
disp("From table 4")
dvf=-5.1*10^-5
dhf=2.7
vf=0.01613
hf=67.97
v=vf+dvf
h=hf+dhf
//results
```

```
printf("Enthalpy = %.2f B/lb",h)
printf("\n Volume = %.5f cu ft/lb",v)
```

Scilab code Exa 10.11 example 11

```
clc
//initialization of varaibles
h1=1183.2 //B/lb
hg=1198.4 //B/lb
hfg=843
//calculations
x=1- (hg-h1)/hfg
//results
printf("Quality = %.3f",x)
```

Chapter 11

Properties of Gases

Scilab code Exa 11.1 example 1

```
clc
//initialization of varaibles
P1=15 //psia
T1=80+460 //R
dm=3 //lb
T2=75+460 //R
P2=25 //psia
//calculations
mratio=P1*T2/(P2*T1)
m2=dm/(1-mratio)
V2=m2*55.16*T2/(P2*144)
//results
printf("Volume of the apparatus = %.1f cu ft",V2)
```

Scilab code Exa 11.2 example 2

```
clc
//initialization of varaibles
```

```
R=48.3 //ft lb/lb R
k=1.4
//calculations
dc=R/778
cp=k*dc/(k-1)
cv=cp/k
//results
printf("Specific heat at constant volume = %.3f B/lb R",cv)
printf("Specific heat at constant pressure = %.3f B/lb R",cp)
```

Scilab code Exa 11.4 example 4

```
clc
//initialization of varaibles
P1=100 //psia
P2=10 //psia
T1=140 +460 //R
g=1.4
cp=0.248
//calculations
dh=g*55.16*T1*((P2/P1)^((g-1)/g) -1)/(g-1)
T2=T1*(P2/P1)^((g-1)/g)
dh2=cp*(T2-T1)
//results
printf("In method 1, Enthalpy = %d Btu/lb",dh*0.01286)
printf("\n In method 2, Enthalpy = %.1f ft lb/lb",dh2)
```

Scilab code Exa 11.5.a example 5

```
clc
//initialization of varaibles
P1=100 //psia
T1=2000+460 //R
P2=15 //psia
g=1.4
cp=0.24
//calculations
v1=53.34*T1/(P1*144)
v2=53.34*T1*(P1/P2)^(1/g) /(P1*144)
T2=T1*P2*v2/(P1*v1)
dh=cp*(T2-T1)
dv=v2-v1
//results
printf("Change in enthalpy = %d B/lb",dh)
printf("\n Specific volume change = %.1f cu ft/lb",
    dv)
```

Scilab code Exa 11.5.b example 6

```
clc
//initialization of varaibles
P1=100 //psia
T1=2000+460 //R
P2=15 //psia
g=1.4
cp=0.276
cv=0.207
T2=1520 //R
//calculations
k=cp/cv
v1=53.34*T1/(P1*144)
v2=v1*(P1/P2)^(1/k)
dh=cp*(T2-T1)
dv=v2-v1
```

```
//results
printf("Enthalpy change = %d B/lb",dh)
printf("\n Volume change = %.1f cu t/lb",dv)
```

Scilab code Exa 11.5.c example 7

```
clc
//initialization of varaibles
P1=100 //psia
T1=2000+460 //R
P2=15 //psia
g=1.4
cp=0.276
cv=0.207
T2=1520 //R
//calculations
h1=634.4
pr1=407.3
pr2=pr1*P2/P1
disp("From table 1,")
T2=1535 //R
h2=378.44
dh=h2-h1
v2=53.34*T2/(P2*144)
dv=v2-v1
//results
printf("Enthalpy change = %.2f B/lb",dh)
printf("\n Volume change = %.1f cu ft/lb",dv)
```

Chapter 12

Properties of Gaseous Mixtures

Scilab code Exa 12.1 example 1

```
clc
//initialization of varaibles
P=15 //psia
T2=70+460 //R
T1=55+460 //R
//calculations
pw=0.2141
pA=P-pw
mratio=pA*29/(pw*18)
mAbym=mratio/(1+mratio)
mwbym=1/(1+mratio)
pg=0.3631 //psia
phi=pw/pg
gamma=1/mratio
//results
printf("Partial pressure of water vapor = %.2f psia"
    ,pA)
printf("\n Specific humidity = %.4f lb vapor/lb air"
    ,gamma)
```

Scilab code Exa 12.2 example 2

```
clc
//initialization of varaibles
rh=0.75
pg=0.5069
inc=10 //in
pA=29.50 //psia
//calculations
pw=rh*pg
p=(29.50+ inc/13.6)*0.491
pA=p-pw
mratio=pw*18/(pA*29)
//results
printf("Pounds of water vapor enter the surface per
   pound of dry air = %.4f lb vapor/lb air",mratio)
```

Chapter 13

process calculations for stationary systems

Scilab code Exa 13.1.a example 1

```
clc
//initialization of varaibles
P1=100 //psia
T1=500+460 //R
v=10 //cu ft
P2=50 //psia
cv=0.172
R=53.34
m=2.81 //lb
//calculations
T2=T1*P2/P1
Q1=P1*144*v*cv*(T2-T1)/(R*T1)
u1=165.26
u2=81.77
du=u2-u1
Q2=m*du
//results
printf("Case 1,")
printf("\n Final temperature of the steam = %d R",T2
```

```
)
printf("\n Heat transferred = %d Btu",Q1+1)
printf("\n Heat transferred in case 2 = %d Btu",Q2
   -1)
```

Scilab code Exa 13.1.b example 2

```
clc
//initialization of varaibles
P1=100 //psia
T1=500+460 //R
V=10 //cu ft
P2=50 //psia
cv=0.172
R=53.34
v=5.589 //cu ft/lb
//calculations
m=V/v
x2=(v-0.017)/8.498
disp("From table 2,")
T2=281.01//F
h1=1279.1
u1=h1-144*P1*v/778
uf=249.93
ufg=845.4
u2=uf+x2*ufg
Q=m*(u2-u1)
//results
printf("Final temperature = %.2f F",T2)
printf("\n Heat transferred = %d Btu",Q)
```

Scilab code Exa 13.2.a example 2

```
clc
//initialization of varaibles
T1=350+460 //R
v1=6 //cu ft/lb
m=1 //lb
R=53.34
v2=2*v1
cp=0.24
//calculations
P=R*T1/(v1*144)
W=P*144*(v2-v1)
T2=T1*v2/v1
Q=cp*(T2-T1)
h1=194.25
h2=401.09
dh=h2-h1
//results
printf("Final temperature = %d F",T2-460)
printf("\n Enthalpy = %.2f B/lb",dh)
printf("\n Heat = %d B/lb",Q)
```

Scilab code Exa 13.2.b example 4

```
clc
//initialization of varaibles
T1=350+460 //R
v1=6 //cu ft/lb
m=1 //lb
R=53.34
v2=2*v1
cp=0.24
//calculations
disp("From steam tables,")
vg=3.342 //cu ft/lb
P1=77.5 //psia
```

```
P2=P1
h1=1204.8  //B/lb
v2=2*v1
T2=1106 //F
h2=1586.7 //B/lb
Q=h2-h1
W=P1*144*(v2-v1)
//results
printf("Final temperature = %d F",T2)
printf("\n Work = %d ft lb/lb",W)
printf("\n Heat = %.1f B/lb",Q)
```

Scilab code Exa 13.3.a example 5

```
clc
//initialization of varaibles
T1=400+460 //R
P1=50 //psia
ratio=1/10
R=53.34
//calculations
P2=P1/ratio
W=R*T1*log(ratio)
du=0
//results
printf("Final pressure =  %d psia",P2)
printf("\n Work done = %.1f B/lb",W)
printf("\n Change in Internal energy = %d ",du)
```

Scilab code Exa 13.3.b example 6

```
clc
//initialization of varaibles
```

```
T1=400+460 //R
P1=50 //psia
ratio=1/10
R=53.34
v1=10.065 //cu ft/lb
vfg=1.8447 //cu ft/lb
vg=1.8633 //cu ft/lb
//calculations
v2=v1*ratio
dx=(v2-vg)/vfg
P2=247.3 //psia
disp("From steam tables,")
u2=773 //B/lb
u1=1141.6 //B/lb
du=u2-u1
s1=1.7349 //B/lb R
s2=1.082 //B/lb R
W=T1*(s2-s1) - du
//results
printf("Final pressure =  %.1f psia",P2)
printf("\n Work done = %d B/lb",W)
printf("\n Change in Internal energy = %d B/lb ",du)
```

Scilab code Exa 13.4.a example 7

```
clc
//initialization of varaibles
P1=150 //psia
T1=400+460 //R
P2=15 //psia
g=1.4
R=53.34
//calculations
Tratio=(P2/P1)^((g-1)/g)
W=53.34*T1*(Tratio-1)/(1-g)
```

```
T2=T1*Tratio
v2=R*T2/(P2*144)
u1=147.50
Pr1=7.149
Pr2=Pr1*P2/P1
disp("From tables,")
Pr=0.7149
T2=447 //R
u2=76.13 //B/lb
W=-(u2-u1)
v2=R*T2/(P2*144)
//results
printf("Final specific volume = %.1f cu ft/lb",v2)
printf("\n Work per pound of fluid = %.1f B/lb",W)
```

Scilab code Exa 13.4.b example 8

```
clc
//initialization of varaibles
disp("From Steam tables,")
h1=1219.4
P1=150 //psia
v1=0.59733 //cu ft/lb
s1=1.5995 //B/lb R
//calculations
u1=h1-P1*v1
sg=1.7549
sfg=1.4415
s2=s1
dx=(sg-s2)/sfg
u2=981.3
W=u1-u2
v2=23.48
//results
printf("Final specific volume = %.2f cu ft/lb",v2)
```

```
printf("\n Work per pound of fluid = %.1f B/lb",W)
```

Scilab code Exa 13.5.a example 9

```
clc
//initialization of varaibles
P1=150 //psia
T1=400+460 //R
P2=15  //psia
n=1.15
cv=0.172
R=53.34
//calculations
v2=R*T1*(P1/P2)^(1/n) /(P1*144)
v1=R*T1/(P1*144)
T2=T1*P2*v2/(P1*v1)
Q=(cv - 0.458)*(T2-T1)
//results
printf("Final specific volume = %.1f cu ft/lb",v2)
printf("\n Final temperature = %d R",T2)
printf("\n Heat transferred = %.1f B/lb",Q)
```

Scilab code Exa 13.5.b example 10

```
clc
//initialization of varaibles
disp("From table 3,")
v1=3.223 //cu ft/lb
P1=150 //psia
T1=400+460 //R
P2=15  //psia
n=1.15
//calculations
```

```
v2=v1*(P1/P2)^(1/n)
T2=213 //F
W=144*(P2*v2-P1*v1)*0.00129/(1-n)
u1=1129.8 //B/lb
v2=23.9
vg=26.29
vfg=26.27
dx=(vg-v2)/vfg
u2=996.1
Q=(u2-u1)+W
//results
printf("Final specific volume = %.1f cu ft/lb",v2)
printf("\n Final temperature = %d F",T2)
printf("\n Heat transferred = %.1f B/lb",Q)
```

Scilab code Exa 13.6.a example 11

```
clc
//initialization of varaibles
v2=15.7 //cu ft/lb
T2=640 //R
cv=0.172
T1=400+460 //R
//calculations
du=cv*(T2-T1)
W=-du
//results
printf("Final specific volume = %.1f cu ft/lb",v2)
printf("\n Final temperature = %d ",T2)
printf("\n Work done = %.1f B/lb",W)
```

Scilab code Exa 13.6.b example 12

```
clc
//initialization of varaibles
disp("From steam tables,")
T2=213 //F
v2=23.9 //cu ft/lb
W=133.7 //B/lb
//results
printf("Final specific volume = %.1f cu ft/lb",v2)
printf("\n Final temperature = %d ",T2)
printf("\n Work done = %.1f B/lb",W)
```

Chapter 14

Vapor cycles rankine cycle

Scilab code Exa 14.1 example 1

```
clc
//initialization of varaibles
P1=200 //psia
T1=750+460 //R
P2=1 //psia
//calculations
disp("From steam tables,")
h1=1399.2
h2=976
h3=69.70
v3=0.01614
dh3=v3*(P1-P2)*144/778
h4=dh3+h3
Q1=h1-h4
Wt=h1-h2
Wp=h4-h3
eta=(Wt-Wp)/Q1
w=2545/Wt
//results
printf("Heat supplied = %d B/lb",Q1+1)
printf("\n Turbine work = %d B/lb",Wt)
```

```
printf("\n Pump work = %.3f B/lb",Wp)
printf("\n Efficiency =  %.3f",eta)
printf("\n Steam rate = %.2f lb steam per hr",w)
```

Scilab code Exa 14.2 example 2

```
clc
//initialization of varaibles
h1=1399.2 //B/lb
h2s=976 //B/lb
wt=8 //lb /hp hr
//calculations
Wt=2545/wt
etaT=Wt/(h1-h2s)
h2=h1-Wt
//results
printf("Engine efficiency = %.3f",etaT)
```

Scilab code Exa 14.3.a example 3

```
clc
//initialization of varaibles
P1=200 //psia
P2=1 //psia
e=0.7
//calculations
h1=1198.4
h2s=863.5
h3r=69.7
h4r=70.3
h3c=300.7
h4c=355.4
disp("For Rankine cycle, ")
```

```
Wtr=h1-h2s
Q1r=h1-h4r
Wpr=h4r-h3r
Wnetr=Wtr-Wpr
eta1=(Wtr-Wpr)/Q1r
wr=2545/Wtr
printf("Back work = %.1f B/lb",Wnetr)
printf("\n Efficiency = %.3f ",eta1)
printf("\n Steam rate = %.1f lb/hp hr",wr)
disp("For carnot cycle,")
Wtc=h1-h2s
Q1c=h1-h4c
Wpc=h4c-h3c
Wnetc=Wtc-Wpc
eta2=(Wtc-Wpc)/Q1c
wc=9.1
printf("Back work = %.1f B/lb",Wnetc)
printf("\n Efficiency = %.3f ",eta2)
printf("\n Steam rate = %.1f lb/hp hr",wc)
```

Scilab code Exa 14.3.b example 4

```
clc
//initialization of varaibles
P1=200 //psia
P2=1 //psia
e=0.7
//calculations
h1=1198.4
h2s=863.5
h3r=69.7
h4r=70.3
h3c=300.7
h4c=355.4
disp("For Rankine cycle with actual machines, ")
```

```
Wtr=e*(h1-h2s)
Q1r=(h1-h4r)
Wpr=(h4r-h3r)/e
Wnetr=Wtr-Wpr
eta1=(Wtr-Wpr)/Q1r
wr=2545/Wtr
printf("Back work = %.1f B/lb",Wnetr)
printf("\n Efficiency = %.3f ",eta1)
printf("\n Steam rate = %.1f lb/hp hr",wr)
disp("For carnot cycle,")
Wtc=e*(h1-h2s)
Q1c=h1-h4c
Wpc=(h4c-h3c)/e
Wnetc=Wtc-Wpc
eta2=(Wtc-Wpc)/Q1c
wc=16.2
printf("Back work = %.1f B/lb",Wnetc)
printf("\n Efficiency = %.3f ",eta2)
printf("\n Steam rate = %.1f lb/hp hr",wc)
```

Chapter 15

Vapor cycles More efficient cycles

Scilab code Exa 15.1 example 1

```
clc
//initialization of varaibles
e=0.85
disp("From Mollier chart and table 3,")
h1=1474.5 //B/lb
s1=1.5603 //B/lb R
h2s=1277.5 //B/lb
//calculations
h2=h1-e*(h1-h2s)
h3=1522.4 //B/lb
h4s=948 //B/lb
h4=h3-e*(h3-h4s)
h5=47.6 //B/lb
h6=53.5 //B/lb
h7s=840 //B/lb
h7=h1-e*(h1-h7s)
h8=1493.2 //B/lb
h9s=866 //B/lb
h9=h8-e*(h8-h9s)
```

```
h11=51.5 //B/lb
eta1=0.401
eta2=0.375
eta3=0.366
IE1=(eta1-eta2)/eta2
IE2=(eta1-eta3)/eta3
//results
printf("Improvement in efficiency = %d percent",IE1
    *100 +1)
printf("\nImprovement in efficiency in case 2= %.1f
    percent",IE2*100)
```

Scilab code Exa 15.2.a example 2

```
clc
//initialization of varaibles
disp("From mollier chart and table 3,")
h1=1371 //B/lb
h2s=1149 //B/lb
h3=118 //B/lb
e=0.9
disp("Neglecting pump work,")
Q1=h1-h3
W=156 //B/lb
eta1=W/Q1
Q=h1-W-h3
UE=W+e*Q
fraction = UE/Q1
//results
printf("Fraction supplied = %.2f",fraction)
```

Scilab code Exa 15.2.b example 3

```
clc
//initialization of varaibles
disp("From mollier chart and table 3,")
h1=1371 //B/lb
h2s=1149 //B/lb
h3=118 //B/lb
e=0.23
e2=0.9
disp("Neglecting pump work,")
Q1=h1-h3
W=156 //B/lb
eta1=W/Q1
Q=h1-W-h3
We=W/e
UE=We+Q
UE1=W+e2*Q
Q2=Q+We
fraction = UE1/UE
//results
printf("Fraction supplied = %.2f",fraction)
```

Chapter 16

Gas cycles

Scilab code Exa 16.1.a example 1

```
clc
//initialization of varaibles
Pb=75 //psia
Pc=15 //psia
k=1.4
Td=550 //R
Tb=1700  //R
cp=0.24
//calculations
disp("Gas law solution")
Pratio=Pb/Pc
Ta=Td*(Pratio)^((k-1)/k)
Tc=Tb/(Pratio)^((k-1)/k)
Q1=cp*(Tb-Ta)
Q2=cp*(Tc-Td)
Wnet=Q1-Q2
eta=Wnet/Q1
eta2=1-Td/Ta
//results
printf("Efficiency in 1= %.3f",eta)
printf("\n Efficiency in 2 = %.2f",eta2)
```

```
printf("\n Work per pound of fluid = %d B/lb",Wnet)
```

Scilab code Exa 16.1.b example 2

```
clc
//initialization of variables
Pb=75 //psia
Pc=15 //psia
k=1.4
Td=550 //R
Tb=1700  //R
cp=0.24
//calculations
Prd=1.4779
hd=131.46 //B/lb
Prb=90.95
hb=422.59 //B/lb
Pratio=Pb/Pc
Pra=Pratio*(Prd)
Ta=868 //R
ha=208.41
Prc=Prb/Pratio
Tc=1113//R
hc=269.27
Q1=hb-ha
Q2=hc-hd
Wnet=Q1-Q2
eta=Wnet/Q1
//results
printf("Efficiency = %.3f",eta)
printf("\n Work per pound of fluid = %.2f B/lb",Wnet
    )
```

Scilab code Exa 16.2 example 3

```
clc
//initialization of varaibles
e=0.75
Ta=870 //R
Tc=1075//R
cp=0.24
Td=550 //R
//calculations
Tadash=e*(Tc-Ta) +Ta
Tcdash=Tc+Ta-Tadash
Q1=cp*(Tb-Tadash)
Q2=cp*(Tcdash-Td)
Wnet=Q1-Q2
eta=Wnet/Q1
//results
printf("Net work done = %d B/lb",Wnet)
printf("\n efficiency = %.2f ",eta)
```

Chapter 17

Fluid Flow Nozzles and Orifices

Scilab code Exa 17.1.a example 1

```
clc
//initialization of varaibles
w=1 //lb/sec
v2=36.4
h1=1279.1 //B/lb
h2=1091.7 //B/lb
V1=100 //fps
//calculations
a2=w*v2/(sqrt(2*32.2*778*(h1-h2) + V1^2)) //sq ft
a2=1.705 //sq in
//results
printf("Exit area = %.3f sq. in",a2)
```

Scilab code Exa 17.1.b example 2

```
clc
//initialization of varaibles
k=1.3
```

```
P=100 //psia
//calculations
Pratio=(2/(k+1))^(k/(k-1))
Pt=Pratio*P
disp("From table 3,")
ht=1221.5 //B/lb
vt=8.841 //cu ft/lb
at=w*vt/1700
//results
printf("Throat area = %.4f sq ft",at)
```

Scilab code Exa 17.2 example 2

```
clc
//initialization of varaibles
k=1.3
P=250 //psia
h0=1263.4 //B/lb
w=10000
cv=0.949
vts=3.415 //cu ft/lb
//calculations
Pratio=(2/(k+1))^(k/(k-1))
Pt=Pratio*P
hts=1208.2 //B/lb
h2s=891 //B/lb
Vts=sqrt(2*32.2*778*(h0-hts))
w=w/3600 //lb/sec
at=w*vts/(Vts)
V2=cv*sqrt(2*32.2*778*(h0-h2s))
etan=cv^2
h2=928 //B/lb
disp("From table 3,")
v2=276 //cu ft/lb
a2=w*v2/V2
```

```
a2s=0.17 //ft^2
Cw=0.98
at2=at/Cw
//results
printf("\n Throat area = %.5f ft^2",at)
printf("\n Exit area = %.3f ft^2",a2)
printf("\n For frictionless nozzle = %.3f ft^2",a2s)
printf("\n Changed throat area = %.5f ft^2 and exit
    area is unchanged",at2)
```

Scilab code Exa 17.3.a example 4

```
clc
//initialization of varaibles
w=1 //lb/sec
Pratio=0.53
k=1.4
T0=800 //R
cp=0.24
P0=150 //psia
P2=15 //psia
//calculations
Pt=Pratio*P0
Tratio=(Pratio)^((k-1)/k)
Tts=T0*Tratio
Vts=sqrt(2*32.2*778*cp*(T0-Tts))
vts=53.34*Tts/(Pt*144)
at=w*vts/(Vts)
T2s=T0*(Pt/P0)^((k-1)/k)
T2=460 //R
V2=sqrt(2*32.2*cp*778*(T0-T2))
v2=53.34*T2/(144*P2)
a2=w*v2/V2
//results
printf("Exit velocity = %d fps",Vts)
```

```
printf("\n Throat area = %.5f ft^2",at)
printf("\n Exit area = %.5f ft^2",a2)
```

Scilab code Exa 17.3.b example 5

```
clc
//initialization of varaibles
h0=191.81 //B/lb
Pr0=5.526
w=1 //lb/sec
Pratio=0.53
k=1.4
T0=800 //R
cp=0.24
P0=150 //psia
P2=15 //psia
//calculations
Prt=Pratio*Pr0
disp("From keenan and kaye steam tables,")
Pr=2.929
Tts=668 //R
hts=159.9 //B/lb
Vts=sqrt(2*32.2*778*(h0-hts))
vts=53.34*Tts/(Pt*144)
at=w*vts/(Vts)
Pr2=P2*Pr0/P0
T2s=415 //R
h2s=99.13 //B/lb
h2=110.25 //B/lb
T2=462 //R
V2=sqrt(2*32.2*778*(h0-h2))
v2=53.34*T2/(144*P2)
a2=w*v2/V2
//results
printf("Exit velocity = %d fps",Vts)
```

```
printf("\n Throat area = %.5f ft^2",at)
printf("\n Exit area = %.5f ft^2",a2)
```

Chapter 18

Turbines

Scilab code Exa 18.1 example 1

```
clc
//initialization of varaibles
drop=50 //B/lb
cv=0.95
Vb=700 //fps
alpha=20 //degrees
beta=30 //degrees
Cb=0.95
//calculations
V1=cv*sqrt(2*32.2*778*drop)
y1=V1*cosd(alpha)
z1=V1*sind(alpha)
y1R=y1-Vb
V1R=sqrt(y1R^2 + z1^2)
V2R=Cb*V1R
y2R=-V2R*cosd(beta)
z2=V2R*sind(beta)
Wx=(y1R-y2R)*Vb/32.2
Fa=(z1-z2)/32.2
Vc=1582.77
etanb=Wx/(Vc^2 /(2*32.2))
```

```
//results
printf("Work per pound of fluid = %d ft lbf/lbm",Wx)
printf("\n Axial thrust = %.1f lbf/lbm/sec",Fa)
printf("\n Nozzle bucket efficiency = %.2f",etanb)
```

Scilab code Exa 18.2 example 2

```
clc
//initialization of varaibles
ha=1187.2 //B/lb
sa=1.6026 //B/lb R
h3s=895 //B/lb
h1s=1090 //B/lb
p1=28 //psia
h2s=993 //B/lb
p2=6.2 //psia
n=0.65
//calculations
disp("From Table 3,")
h1=ha-n*(ha-h1s)
s1=1.65 //B/lb R
h2dash=1024 //B/lb
h2=h1-n*(h1-h2dash)
s2=1.706 //B/lb R
h3dash=953 //B/lb
h3=h2-n*(h2-h3dash)
etaT=(ha-h3)/(ha-h3s)
reheat=etaT/n
//results
printf("Internal efficiency = %.3f",etaT)
printf("\n Reheat factor = %.2f",reheat)
```

Chapter 19

Reciprocating expanders and compressors

Scilab code Exa 19.1 example 1

```
clc
//initialization of varaibles
disp("From tables,")
h1=1185.3 //B/lb
v1=4.896 //cu ft/lb
v2=23.66 //cu ft/lb
h2=1054.3 //B/lb
Pd1=1 //cu ft
Pd2=0.98 //cu ft
N=300 //rpm
//calculations
Wx=h1-h2
Pd=Pd1+Pd2
Cl=0.05
mf=Pd*(1-Cl*(v2/v1 - 1))/v2
P=Wx*mf*N/(2545/60)
mep=P*33000/(N*Pd)
//results
printf("Horsepower output = %.3f hp",P)
```

```
printf("\n Mean effective pressure = %d psf",mep)
//The answers in the book are a bit different due to
    round off error.
```

Scilab code Exa 19.2 example 2

```
clc
//initialization of varaibles
R=53.34
T1=540 //R
P1=15 //psia
T2=720 //R
P2=60 //psia
PD=150 //cu ft/min
p1=0.03
p2=0.06
//calculations
v1=R*T1/(P1*144)
vratio=T1*P2/(P1*T2)
Nmf=PD*(1-p1*(vratio-1))/v1
Nmf2=PD*(1-p2*(vratio-1))/v1
//results
printf("For clearance of 3 percent, Mass per min = %
    .1f lb/min",Nmf)
printf("\n For clearance of 6 percent, Mass per min
    = %.1f lb/min",Nmf2)
```

Chapter 21

Gas compression

Scilab code Exa 21.1 example 1

```
clc
//initialization of varaibles
R=53.34
T1=540 //R
n=1.4
g=n
n2=1.3
P2=90 //psia
P1=15 //psia
cv=0.171
//calculations
pv=R*T1
Wk=n*R*T1*((P2/P1)^((g-1)/g) -1) /(n-1)
Wn=n2*R*T1*((P2/P1)^((n2-1)/n2) -1) /(n2-1)
Wt=R*T1*log(P2/P1)
Q=cv*(n-n2)*778*T1*((P2/P1)^((n2-1)/n2) -1) /(1-n2)
//results
printf("\n Work in case 1 = %d ft lb/lb",Wk)
printf("\n Work in case 2 = %d ft lb/lb",Wn)
printf("\n Work in case 3 = %d ft lb/lb",Wt)
printf("\n Heat transferred = %.1f B/lb",Q*0.001305)
```

Scilab code Exa 21.2 example 2

```
clc
//initialization of varaibles
R=53.34
T1=540 //R
n=1.4
g=n
n2=1.3
P2=90 //psia
P1=15 //psia
cv=0.171
//calculations
pv=R*T1
Wk=n*R*T1*((P2/P1)^((g-1)/g) -1) /(n-1)
Wn=n2*R*T1*((P2/P1)^((n2-1)/n2) -1) /(n2-1)
Wt=R*T1*log(P2/P1)
eta1=Wt/Wn
eta2=Wk/Wn
//results
printf("Adiabatic efficiency = %.2f",eta2)
printf("\n Isothermal efficiency = %.2f",eta1)
```

Scilab code Exa 21.3 example 3

```
clc
//initialization of varaibles
R=53.34
T1=540 //R
n=1.4
g=n
```

```
n2=1.3
P2=90 //psia
P1=15 //psia
cv=0.171
eta=0.95
//calculations
pv=R*T1
Wk=n*R*T1*((P2/P1)^((g-1)/g) -1) /(n-1)
Wn=n2*R*T1*((P2/P1)^((n2-1)/n2) -1) /(n2-1)
Wt=R*T1*log(P2/P1)
Wx=-Wk/eta
dh=cp*T1*(1.52 - 1)
Q=dh+Wx/778
//results
printf("Heat transferred = %.1f B/lb",Q)
```

Scilab code Exa 21.4 example 4

```
clc
//initialization of varaibles
n=1.3
P1=15 //psia
P2=75 //psia
eta=0.5
eta2=0
//calculations
Pr=(P2/P1)^(1/n)
Cl=(1-eta)/(Pr-1)
Cl2=(1-eta2)/(Pr-1)
//results
printf("For volumetric efficiency to be 0.5,
    Clearance = %.3f",Cl)
printf("\n For volumetric efficiency to be 0,
    Clearance = %.3f",Cl2)
```

Scilab code Exa 21.5 example 5

```
clc
//initialization of varaibles
P1=5 //psia
P2=83.5 //psia
n=1.25
per=0.03
//calculations
nv1=1- per*((P2/P1)^(1/n) -1)
nv2=1-per*((sqrt(P2/P1))^(1/n) -1)
//results
printf("For single stage machine = %.3f",nv1)
printf("\n For Two stage machine = %.3f",nv2)
```

Chapter 22

Combustion Processes First law analysis

Scilab code Exa 22.5 example 1

```
clc
//initialization of varaibles
mO=1.33
CO=0.155
mC=3.67
CC=0.165
t2=1000 //F
tb=68 //F
t1=300 //F
mC2=1
CC2=0.17
mO2=4
CO2=0.155
H=-14087 //B/lb
//calculations
dE2=mO*CO*(t2-tb) + mC*CC*(t2-tb)
dE1=mO2*CO2*(tb-t1) + mC2*CC2*(tb-t1)
Q=dE2+dE1+H
//results
```

```
printf("Heat transfer from the system = %d Btu",Q)
```

Scilab code Exa 22.6 example 2

```
clc
//initialization of varaibles
H1=17889 //Cal/g
H2=-94052 //Cal/g
H3=2* -68317 //Cal/g
//calculations
x=H1+H2+H3
//results
printf("Constant pressure heating value of methane =
    %d cal/gm formula wt.",x)
```

Scilab code Exa 22.7 example 3

```
clc
//initialization of varaibles
HV=4344 //B/lb
xC=56 //lb
R=1.986
T=530 //R
MC=56 //g/mol
//calculations
HR=xC*HV
Eb=-HR -R*T*(2-3)
HV=-Eb/MC
//results
printf("COnstant volume heating value = %d B/lb ",HV
   )
```

Scilab code Exa 22.8 example 4

```
clc
//initialization of varaibles
dH2=14087 //B/lb
xc=3.67 //lb
xN=8.78 //lb
tb=100 //F
//calculations
dt2=dH2/(xc*0.196 + xN*0.248)
t2=dt2+tb
//results
printf("products temperature = %d F",t2)
```

Scilab code Exa 22.9 example 5

```
clc
//initialization of varaibles
Heat=14087 //Btu/lb
x1=0.9 //lb
x2=0.05 //lb
x3=0.05 //lb
Heat2=3952 //Btu/lb
//calculations
h1=x1*Heat
h2=x2*Heat2
e=(h1+h2)/Heat
//results
printf("Efficiency = %.2f",e)
```

Scilab code Exa 22.10 example 6

```
clc
//initialization of varaibles
disp("From data and steam tables,")
Q=10240000 //B/hr
w=700 //lb/hr
h=19500 //B/lb
//calculations
HV=w*h
e=Q/HV
//results
printf("Efficiency = %.2f",e)
```

Chapter 23

Internal combustion power plants

Scilab code Exa 23.1 example 1

```
clc
//initialization of varaibles
disp("from chart")
T6=2600 //R
mratio=0.05
V6d=82 //cu ft
E6d=465 //Btu
H6d=655 //Btu
T6d=2480 //R
Hs=58 //Btu
LHV=19256
//calculations
H1=mratio*H6d + (1-mratio)*Hs
dV=22-3.67
PD=0.12
Work=446*PD/dV
pm=Work*778/(144*PD)
eta=446/((1-mratio)*(LHV*0.0665))
//results
```

```
printf("Efficiency = %.3f",eta)
printf("\n Mean effective pressure = %d psi",pm)
printf("\n Work per machine cycle = %.2f Btu",Work)
```

Scilab code Exa 23.2 example 2

```
clc
//initialization of varaibles
f=0.03
T6=1500 //R
disp("from air tables,")
hi=131.46 //B/lb
h6=381 //B/lb
vratio=1/15
v1r=120.7
P1=15 //psi
T1=580 //R
x=0.5
Tb=520 //R
H=18500 //B/lb
mh=0.0345
m3=1.065
//calculations
h1=f*h6+(1-f)*hi
v2r=v1r*vratio
T2=1615 //R
u2=289.05 //B/lb
P2=T2*1/vratio *P1/T1
theo=0.069 //lb/lb of air
m=theo*x
h3B=0.242*Tb
m3=1+0.03+0.0345
h3=(638+284)/1.065 +h3B
T3=3520 //R
P3=626 //psi
```

```
v3=53.34*T3/(P3*144)
v3p=v3*m3
v1=53.35*T1/(144*P1)
v2=14.7/P1
m1=1.03
h3=992
h4=531
T3=3520 //R
T4=2030 //R
W12=m1*(98.9-289.05)
W23=P2*(v3p-v2)*144/778
W34=m3*(h3-h4-53.4*(T3-T4)/778)
W=W12+W23+W34
eta=W/(mh*H)
//results
printf("Efficiency = %.3f",eta)
```

Scilab code Exa 23.3 example 3

```
clc
//initialization of varaibles
disp("Using air tables,")
h1=124.27
pr1=1.2147
p2byp1=6
p1=15
p4=15
eta=0.8
//calculations
pr2=p2byp1*pr1
h2s=197.5
h2=h1+(h2s-h1)/eta
h2B=124.3
dhB=-18500 //B/lb
dh2=h2B-h2
```

```
T3=1910 //R
h3=479.85
pr3=144.53
h3B=h2B
dh3=h3-h3B
wratio=(-dh3-dh2)/(dh3+dhB)
pr4=28.91
h4s=306.9
h4=h3-eta*(h3-h4s)
Wt=(1+wratio)*(h3-h4)
Wc=(h2-h2B)
Wnet=Wt-Wc
E=Wnet/(wratio*-dhB)
rate=2545/Wnet
BWratio=Wc/Wnet
//results
printf("Efficiency = %.3f",E)
printf("\n Air rate = %.1f lb air/hp hr",rate)
printf("\n Back work ratio = %.2f",BWratio)
```

Scilab code Exa 23.4 example 4

```
clc
//initialization of varaibles
V1=587 //fps
etaD=0.9
etaC=0.8
h1=114.69
P1=10 //psia
P6=P1
dhB=-19100 //B/lb
T1=480 //R
//calculations
h2s=etaD*V1^2 /(778*2*32.2) +h1
disp("From tables,")
```

```
Pr2s=1.104
Pr1=0.9182
P2=P1*Pr2s/Pr1
h2=h1+(h2s-h1)/etaD
T2=509 //R
Pr2=1.127
Pr3s=Pr2*P3/P2
Pr3s=6.76
h3s=203.2
h3=(h3s-h2)/etaC +h2
T3=930 //R
P3=6*P2
T4=2160 //R
h4=549.35
Pr4=238
h4B=126.66
dh4=422.7
h3B=h4B
dh3=h3-h3B
cp=0.5
Ta=480 //R
Tb=530 //R
dhf=cp*(Tb-Ta)
wratio=(-dh4+dh3)/(dh4+dhf+dhB)
h5s=425.3
Pr5s=93.1
P5=27.6
T5=1801 //R
Pr5=114.28
Pr6s=Pr5*P6/P5
h5=450
h6=351
V6=sqrt(2*32.2*778*(h5-h6))
SI=((1+wratio)*V6 -V1)/(32.2)
v1=53.34*T1/(P1*144)
wa=V1/v1
thrust = wa*SI
SC=wa*0.0174*3600/1840
```

```
eff=2545/(SC*-dhB)
//results
printf("Specific impulse = %.1f lb/lb per sec of air
   ",SI)
printf("\n Thrust = %d lb",thrust)
printf("\n Efficiency = %.3f",eff)
```

Chapter 24

Refrigeration

Scilab code Exa 24.1 example 1

```
clc
//initialization of varaibles
disp("From tables,")
h1=611.8 //B/lb
h2=704.4 //B/lb
h3=127.4 //B/lb
h4=h3
T2=460 //R
T1=76+460 //R
W=10000 //B/hr
e=0.7
//calculations
Qe=h1-h4
Wc=h2-h1
CP=Qe/Wc
CP2=T2/(T1-T2)
w=W/(Qe*60)
v1=9.116 //cu ft/lb
PD=w*v1/(e)
//results
printf("Coefficient of performance in case 1 = %.2f"
```

```
    ,CP)
printf("\n Coefficient of performance in case 2 = %
    .2f",CP2)
printf("\n Piston displacement = %.2f cu ft/min",PD)
```

Chapter 25

Air water vapor mixtures

Scilab code Exa 25.1 example 1

```
clc
//initialization of varaibles
Pg=0.4298 //steam tables psi
phi=0.5
P=14.7 //psi
//calculations
pw=phi*Pg
Pa=P-pw
gamma=0.622*pw/Pa
T=55 //F from dew point tables
//results
printf("Specific humidity = %.5f lb water/lb dry air
    ",gamma)
printf("\n Dew temperature = %d F",T)
```

Scilab code Exa 25.2 example 2

```
clc
```

```
//initialization of varaibles
disp("From psychrometric chart ,")
hgdp=1061.8
cpw=0.44
tdb=72 //F
cp=0.24
g=0.0071
//calculations
rh=0.42
sp=g
tdp=58 //F
hw=hgdp+cpw*tdb
h=cp*tdb+g*hw
//results
printf("Enthalpy = %.2f B/lb dry air",h)
printf("\n relative humidity = %.2f ",rh)
printf("\n specific humidity = %.2f ",sp)
printf("\n Dew point temperature = %d F",tdp)
```

Scilab code Exa 25.3 example 3

```
clc
//initialization of varaibles
disp("From the psychrometric chart,")
ha=12.9 //B/lb
g1=0.0032 //lb water/ lb dry air
g2=0.0078 //lb water/ lb dry air
hl=13 //B/lb
hd=25.33 //B/lb
p=14.7 //psia
phi=0.6
cp=0.24
t2=70 //F
//calculations
wl=g2-g1
```

```
Q=hd-ha-wl*hl
pg=0.1217 //psia
pa=p-pg
G1=0.622*pg*phi/pa
G2=0.00788
wl2=G2-G1
t1=40 //F
hw1=1061.8 + 0.44*t1
hw2=1092.6 //B/lb
Q2=cp*(t2-t1) + G2*hw2 -G1*hw1 - wl2*hl
//results
printf("Method 1")
printf("\n Water to be supplied = %.4f lb/lb of dry air",wl)
printf("\n heat supplied = %.1f B/lb of dry air",Q)
printf("\n Method 2")
printf("\n Water to be supplied = %.5f lb/lb of dry air",wl2)
printf("\n heat supplied = %.1f B/lb of dry air",Q2)
```

Scilab code Exa 25.4 example 4

```
clc
//initialization of varaibles
disp("From psychrometric charts,")
e=0.7
phi=0.5
g1=0.0131 //lb water/lb dry air
h1=32.36 //B/lb of dry air
g3=0.0073
h3=24.26
pg=0.3390
T3=528 //R
V3=1000
Rw=85.8
```

```
//calculations
pw3=phi*pg
ww3=pw3*144*V3/(Rw*T3)
wa3=ww3/g3
wa1=phi*wa3
wa2=phi*wa3
ww1=g1*wa1
ww2=ww3-ww1
g2=ww2/wa2
h2=(wa3*h3-wa1*h1)/wa2
tdb=61 //F
//results
printf("Air supplied = %.3f lb/min",ww2)
printf("\n temperature = %d F",tdb)
printf("\n Humidity = %.5f lb water/lb dry air",g2)
```

Scilab code Exa 25.5 example 5

```
clc
//initialization of varaibles
disp("From psychrometric charts,")
g1=0.0131 //lb water/lb dry air
g2=0.0093 //lb water/lb dry air
h1=32.36 //B/lb dry air
h2=27.03
hd2=23.4 //B/lb dry air
hf=23.4  //B/lb dry air
hw1=1094.5
//calculations
tdp=55.3 //F
wratio=g1-g2
Qc=hd2-h1+wratio*hf
Qh=h2-hd2
Heat=wratio*(hw1-hf)
frac=-Heat/Qc
```

```
//results
printf("Cooling temperature = %.1f F",tdp)
printf("\n heat transfer = %.2f B/lb dry air",Heat)
printf("\n Fraction of heat removed = %.2f",frac)
```