

Scilab Textbook Companion for  
Elements Of Thermal Technology  
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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.

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# Chapter 1

## Thermodynamic Definitions and Concepts

Scilab code Exa 1.1 Chapter 1 example 1

```
1 clc
2 //initialisation of variables
3 Vf= 0.019014 //ft^3/lbm
4 Vg= 1.4249 //ft^3/lbm
5 T= 425 //fahrenheit
6 quality= 60 //%
7 //CALCULATIONS
8 Vfg= Vg-Vf
9 V= (quality/100)*Vg+(1-(quality/100))*Vf
10 V1= Vf+(quality/100)*Vfg
11 V2= Vg-(1-(quality/100))*Vfg
12 //RESULTS
13 printf ( ' Vfg= %.4 f ft ^3/lbm ',Vfg)
14 printf ( ' \n V= %.4 f ft ^3/lbm ',V)
15 printf ( ' \n V= %.4 f ft ^3/lbm ',V1)
16 printf ( ' \n V= %.4 f ft ^3/lbm ',V2)
```

---

Scilab code Exa 1.2 Chapter 1 example 2

```
1 clc
2 //initialization of variables
3 tsat=431.82 //F
4 vf=0.019124 //ft^3/lbm
5 vg=1.3267 //ft^3/lbm
6 //Calculations
7 disp('From keenan and keyes steam tables , at 500 f
      and 350 psia ,')
8 v=1.4913 //ft^3/lbm
9 //Results
10 printf('\\n Specific volume = %.4f ',v)
```

---

Scilab code Exa 1.3 Chapter 1 example 3

```
1 clc
2 //initialisation of variables
3 T= 100 //degrees
4 P= 200 //bar
5 //CALCULATIONS
6 Psat= 1.0135 //bar
7 Vf= 1.0435 //cm^3/gm
8 V= 1.0337 //cm^3/gm
9 v= Vf-V
10 //RESULTS
11 printf ('Amount of liquid compressed= %.4f cm^3/gm',
      v)
```

---

# Chapter 2

## Units and Dimensions

Scilab code Exa 2.1a Chapter 2 example 1a

```
1 clc
2 //initialisation of variables
3 F= 1//N
4 L= 1//m
5 T= 1//s
6 I= 1//N m s2
7 N= 1//Kg m s-2
8 //CALCULATIONS
9 I= F*L*T2 //Kg m2
10 //RESULTS
11 printf ('I in SI system= %.f Kg m2',I)
```

---

Scilab code Exa 2.1b chapter 2 example 1b

```
1 clc
2 //initialisation of variables
3 F= 1//lbf
4 L= 1//ft
```

```

5 T= 1//s
6 I= 1//lbf ft s^2
7 lbf= 1//slug ft s^-2
8 //CALCULATIONS
9 I= F*L*T^2 //slug ft^2
10 //RESULTS
11 printf (' I in British Gravitational System = %.f
        slug ft^2 ',I)

```

---

### Scilab code Exa 2.2 chapter 2 example 2

```

1 clc
2 //initialisation of variables
3 F= 1 //Pounda
4 m= 1 //lbm
5 g= 1 //fts^-2
6 //CALCULATIONS
7 gc= m*g/F
8 //RESULTS
9 printf ('gc= %.2f lbm ft/poundal^2 ',gc)

```

---

### Scilab code Exa 2.3 chapter 2 example 3

```

1 clc
2 //initialisation of variables
3 h= 76 //cmhg
4 g= 32.2 //ft/s^2
5 h= 76.0 //cmHg
6 Dhg= 847 //lbm/ft^3
7 //CALCULATIONS
8 Pa= Dhg*g*h*0.33
9 Pa1= Pa/1
10 //RESULTS

```

```
11 printf ( 'Pa= %.f poundal/ft ^2 ', Pa1)
```

---

# Chapter 3

## Tem

Scilab code Exa 3.1 Chapter 3 example 1

```
1  clc
2  //initialisation of variables
3  T1= -3 //degrees
4  T2= 650 //Rankine
5  T3= 650 //Rankine
6  //CALCULATIONS
7  t1= (9/5)*T1+32
8  t2= T2-459.67
9  t21= (5/9)*(t2-32)
10 t3= t21+273.15
11 //RESULTS
12 printf ('T= %.2 f F',t1)
13 printf (' \n T= %.2 f C',t21)
14 printf (' \n T= %.2 f K',t3)
```

---

Scilab code Exa 3.2 chapter 3 example 2

```
1  clc
```

```

2 //initialisation of variables
3 T1= 40 //degrees
4 T2= 30 //degrees
5 //CALCULATIONS
6 d1= (T1-T2)*(9/5)
7 d2= d1
8 //RESULTS
9 printf ('T= %.2 f F',d1)
10 printf ('\n T= %.2 f R',d2)

```

---

**Scilab code Exa 3.3** chapter 3 example 3

```

1 clc
2 //initialisation of variables
3 l= 400 //mm
4 t1= 20 //degrees
5 t2= 90 //degrees
6 alpha= 19.3*10^-6 //degrees^-1
7 //CALCULATIONS
8 L= alpha*(t2-t1)*l
9 L1= L+1
10 //RESULTS
11 printf ('L= %.2 f mm',L1)

```

---

**Scilab code Exa 3.4** chapter 3 example 4

```

1 clc
2 //initialisation of variables
3 d= 2.98 //in
4 T1= 69 //F
5 T2= -15 //F
6 alpha= 22.7*10^-6 //C^-1
7 //CALCULATIONS

```

```
8 A0= %pi*d^2/4
9 alpha1= alpha/1.8
10 A= 2*alpha1*A0*(T1-T2)
11 A1= A0-A
12 d1= sqrt(4*A1/%pi)
13 //RESULTS
14 printf ('diameter at -15 = %.3f in ',d1)
```

---



# Chapter 4

## viscosity

Scilab code Exa 4.1 Chapter 4 example 1

```
1 clc
2 //initialisation of variables
3 V= 1 //cp
4 //CALCULATIONS
5 SI= V*10-2/10
6 BE= (V*10-2*32.2)/(4.788*102)
7 RE= V*10-2/(4.788*102*144)
8 //RESULTS
9 printf ('SI units= %.2e Pa s',SI)
10 printf (' \n BE units= %.2e lbm/ft s',BE)
11 printf (' \n Reyns units= %.2e reyn',RE)
```

---

Scilab code Exa 4.2 chapter 4 example 2

```
1 clc
2 //initialisation of variables
3 T= 68 //F
4 d= 1.0 //gm/cm3
```

```

5 mu= 10^-2 //gm/cm s
6 SIm= 10^-4 //m^2/s
7 m= 10.76 //ft
8 //CALCULATIONS
9 SI= mu*SIm
10 BU= SI*m
11 //RESULTS
12 printf ('SI Units= %.2e m^2/s',SI)
13 printf ('\n British Units= %.2e ft/s',BU)

```

---

#### Scilab code Exa 4.3 chapter 4 example 3

```

1 clc
2 //initialisation of variables
3 Ku= 40 //SUS
4 //CALCULATIONS
5 SU= 0.0022*Ku-(1.8/Ku)
6 //RESULTS
7 printf ('Stoke Units= %.3f stoke',SU)

```

---

#### Scilab code Exa 4.4 chapter 4 example 4

```

1 clc
2 //initialisation of variables
3 v= 50 //fps
4 mu= 1.6*10^-4 //ft^2/s
5 d1= 10 //in
6 d2= 10 //in square
7 //CALACULATIONS
8 D= (%pi*4*d1^2/4)/(%pi*d2*12)
9 Re= (v*D)/mu
10 D1= (d1^2/(4*d2*3))
11 Re1= (v*D1)/mu

```

```
12 //RESULTS
13 printf ( 'Re= %.3e ',Re)
14 printf ( ' \n Re= %.3e ',Re1)
```

---

Scilab code Exa 4.5 chapter 4 example 5

```
1 clc
2 //initialisation of variables
3 v= 1.75*10^-3 //pa s
4 l= 1 //m
5 P= 1 //Mpa
6 d= 0.5 //mm
7 //CALCULATIONS
8 Q= (%pi*P*10^6*((d/2)*10^-3)^4)/(1*8*v)
9 //RESULTS
10 printf ( 'Q= %.2e Ns/m^2 ',Q)
```

---

# Chapter 5

## Surface Tension

Scilab code Exa 5.1 Chapter 5 example 1

```
1 clc
2 //initialisation of variables
3 St= 0.04 //N/m
4 d1= 5 //cm
5 d2= 15 //cm
6 //CALCULATIONS
7 W= St*103*2*4*%pi*((d2/2)2-(d1/2)2)
8 //RESULTS
9 printf ('Work= %.2e dyn cm or erg ',W)
```

---

Scilab code Exa 5.2 chapter 5 example 2

```
1 clc
2 //initialisation of variables
3 R= 0.017 //in
4 sigma= 72.8 //m N/m
5 //CALCULATIONS
6 P= (2*sigma*0.005*0.017)/(72.8*R*7.08*10-4)
```

```
7 //RESULTS
8 printf ('Pressure difference= %.1f lbf/ft^2',P)
```

---

### Scilab code Exa 5.3 chapter 5 example 3

```
1 clc
2 //initialisation of variables
3 d= 13.6 //gm/cm^3
4 g= 980 //cm/s^2
5 D= 0.4 //mm
6 angle= 130 //degrees
7 s= 514 //dyn/cm
8 //CALCULATIONS
9 h= (4*s*cosd(angle))/(d*g*D*10^-1)
10 //RESULTS
11 printf (' Difference in mercury level= %.2f cm (
    depression)',h)
```

---

# Chapter 6

## work and heat

Scilab code Exa 6.1 Chapter 6 example 1

```
1 clc
2 //initialisation of variables
3 m= 5 //kg
4 h= 10 //m
5 gc= 1.0 //kg m/N s^2
6 //CALCULATIONS
7 v2= 2*h*gc*9.8
8 KE= (m*v2)/(2*gc)
9 PE= (m*gc*9.8*h)/(gc)
10 //RESULTS
11 printf ('KE= %.f J ',KE)
12 printf (' \n PE= %.f J ',PE)
```

---

Scilab code Exa 6.2 chapter 6 example 2

```
1 clc
2 //initialisation of variables
3 T= 149 //F
```

```

4 p= 20
5 //CALCULATIONS
6 h= 116.96+(p/100)*1008.7
7 //RESULTS
8 printf ( 'h= %.1 f Btu/lbm ',h)

```

---

#### Scilab code Exa 6.3 chapter 6 example 3

```

1 clc
2 //initialisation of variables
3 F= 30 //lb
4 w= 40 //lb
5 l= 10 //ft
6 t= 2 //sec
7 mu= 0.1
8 //CALCULATIONS
9 f= mu*w
10 W= F*l-f*l
11 FW= f*l
12 Fhp= FW/(550*t)
13 //RESULTS
14 printf ( 'Total work done= %.f ft lbf ',W)
15 printf ( ' \n FW= %.f ft lbf ',FW)
16 printf ( ' \n Frictional horsepower= %.3 f hp ',Fhp)

```

---

#### Scilab code Exa 6.4 chapter 6 example 4

```

1 clc
2 //initialisation of variables
3 N= 40 //lbf
4 mu= 0.1
5 l= 10 //ft
6 J= 778 //ft lbf/Btu

```

```

7 //CALCULATIONS
8 f= mu*N
9 FW= f*l
10 n= FW/J
11 //RESULTS
12 printf ('No of Btu involved= %.3f ft Btu',n)

```

---

Scilab code Exa 6.5 chapter 6 example 5

```

1 clc
2 //initialisation of variables
3 M= 50. //gm
4 T= 98. //C
5 Mw= 75. //gm
6 T1= 19. //C
7 Tm= 27. //C
8 Mc= 123. //gm
9 SH= 0.1 //cal gm-1 C-1
10 Qinst= 6.5 //cal
11 //CALCULATIONS
12 c= (Mc*SH+Mw+Qinst)/(M*(T-Tm))
13 //RESULTS
14 printf ('Mean specific heat of the metal sample= %.4
        f cal/C gm',c)
15 //The answer given in textbook is Wrong

```

---

Scilab code Exa 6.6 chapter 6 example 6

```

1 clc
2 //initialisation of variables
3 Mw= 500 //gm
4 Tw= 80 //C
5 Ti= -4 //F

```



```
6 Tf= 50 //C
7 ci= 0.5 //cal/gm
8 L= 79.7 //cal/gm
9 cw= 1 //cal/gm
10 Dt= Tw-Tf
11 //CALCULATIONS
12 Tf1= (5/9)*(Ti-32)
13 Dt1= Tf1-Tf
14 m= (Mw*cw*Dt)/(ci*(-Dt1)+L)
15 //RESULTS
16 printf ('Grams of ice can be added= %.f gm',m)
```

---

# Chapter 7

## First Law of Thermodynamics

Scilab code Exa 7.1 Chapter 7 example 1

```
1 clc
2 //initialisation of variables
3 m= 3000 //lb
4 Z1= 50 //ft
5 V1= 50 //mph
6 gc= 32.2 //ft/lbf s^2
7 V2= 0 //mph
8 g= 32.2 //ft/s^2
9 Z2= 0 //ft
10 //CALCULATIONS
11 V1= V1*(73.3/50)
12 Q2= ((m*(V2^2-V1^2))/(2*gc))+((m*g)/gc)*(Z2-Z1)
13 //RESULTS
14 printf ('Energy dissipated from the brakes= %.e ft
    lbf ',-Q2)
```

---

Scilab code Exa 7.2 chapter 7 example 2

```

1  clc
2  //initialisation of variables
3  P= 15 //bar
4  T= 300 //C
5  h1= 3043.1 //J/gm
6  //CALCULATIONS
7  u2= h1
8  T= 453.4
9  //RESULTS
10 printf ('Temperature of the steam in the tank= %.1f
    C',T)

```

---

**Scilab code Exa 7.3** chapter 7 example 3

```

1  clc
2  //initialisation of variables
3  m= 10 //lbf
4  T= 120 //F
5  T1= 275 //F
6  u1= 98.9 //Btu/lbm
7  u2= 125.6 //Btu/lbm
8  //CALCULATIONS
9  Q= m*(u2-u1)
10 //RESULTS
11 printf ('Heat transferred to the tank= %.f Btu',Q)

```

---

**Scilab code Exa 7.4** chapter 7 example 4

```

1  clc
2  //initialisation of variables
3  v0= 1 //m/s
4  vi= 60 //m/s
5  Q= -500 //J/s

```

```

6 m= 500 //gm/s
7 hi= 2000 //J/gm
8 h0= 1800 //J/gm
9 zi= 3 //m
10 z0= 0 //m
11 g= 9.8 //m/s^2
12 gc= 10^3 //gm m/Ns^2
13 //CALCULATIONS
14 W= Q+m*((hi-h0)+(vi^2-v0^2)/(2*gc)+(g/gc)*(zi-z0))
15 //RESULTS
16 printf ('Maximum theoretical power that can be
    devoloped= %.e J/s ',W)

```

---

#### Scilab code Exa 7.5 chapter 7 example 5

```

1 clc
2 //initialisation of variables
3 m= 0.3 //lt/s
4 T= 82 //C
5 P= 2.4 //bar
6 p= 80
7 Tw= 800 //C
8 h1= 67.19 //J/gm
9 h3= 343.3 //J/gm
10 hf= 529.65 //J/gm
11 hfg= 2185.4 //J/gm
12 v3= 1.0305 //cm^3/gm
13 V3= 300 //cm^3/s
14 //CALCULATIONS
15 h2= hf+(p/100)*hfg
16 m3= V3/v3
17 m2= (m3*(h3-h1))/(h2-h1)
18 //RESULTS
19 printf ('Required steam flow rate= %.1f gm/s ',m2)

```

---

Scilab code Exa 7.6 Chapter 7 example 6

```
1 clc
2 //initialisation of variables
3 h2= 2 //J/gm
4 h1= 1 //J/gm
5 //CALCULATIONS
6 L= h2-h1
7 //RESULTS
8 printf ('Difference between the enthalpies of the
   system in the two phases= %.f (h2-h1) J/gm',L)
```

---

# Chapter 8

## Second Law of Thermodynamics

Scilab code Exa 8.1 Chapter 8 example 1

```
1  clc
2  //initialisation of variables
3  W= 25 //Btu
4  W1= 100 //Btu
5  T1= 140 //R
6  T2= 0 //R
7  //CALCULATIONS
8  Th= T1+460
9  Tl= T2+460
10 nt= (Th-Tl)/Th
11 n= nt*100
12 //RESULTS
13 printf ('maximum theoretical efficiency= %.1f (Claim
        is not valid)',n)
```

---

Scilab code Exa 8.2 chapter 8 example 2

```

1  clc
2  //initialisation of variables
3  P= 10 //bar
4  P1= 38 //bar
5  T= 310 //C
6  v= 64.03 //cm3/gm
7  s= 6.4415 //J/gm K
8  vf= 1.12773 //cm3/gm
9  vg= 194.44 //cm3/gm
10 sf= 2.1387 //J/gm K
11 sfg= 4.4478 //J/gm K
12 //CALCULATIONS
13 x= (v-vf)/(vg-vf)
14 sx= sf+x*sfg
15 S= s-sx
16 //RESULTS
17 printf ('Change in Entropy= %.3 f J/gm',S)

```

---

### Scilab code Exa 8.3 chapter 8 example 3

```

1  clc
2  //initialisation of variables
3  Qh= 70000 //Btu/hr
4  T= 15 //F
5  T1= 72 //F
6  //CALCULATIONS
7  COP= (T1+460)/((T1+460)-(T+460))
8  W= Qh/COP
9  //RESULTS
10 printf ('Minimum power required to drive the heat
    pump= %. f Btu/hr',W)

```

---

### Scilab code Exa 8.4 chapter 8 example 4

```
1 clc
2 //initialisation of variables
3 h= 26 //KW
4 T= 43 //C
5 To= 0 //C
6 //CALCULATIONS
7 COP= (T+273)/((T+273)-(To+273))
8 W= h/COP
9 Qh=h
10 //RESULTS
11 printf ('Minimum electrical requirement = %.2f KW',
W)
12 printf ('\n Elctrical requirement if an electrical
heater used= %.f KW',Qh)
```

---



# Chapter 9

## Gas Properties and Processes

Scilab code Exa 9.1 Chapter 9 example 1

```
1 clc
2 //initialisation of variables
3 v= 15 //ft^3
4 m= 20 //lbm
5 T= 80 //lbf
6 P= 320 //psia
7 //CALCULATIONS
8 R= P*144*v/(m*(T+460))
9 M= 1545/R
10 //RESULTS
11 printf ('Molecular weight of the gas = %.1f lbm/lbm
    mol',M)
```

---

Scilab code Exa 9.2 chapter 9 example 2

```
1 clc
2 //initialisation of variables
3 V= 50 //lit
```

```

4 P= 20 //atm
5 T= 30 //C
6 P1= 6 //atm
7 T1= 10 //C
8 M= 32 //gm/gm mol
9 //CALCULATIONS
10 n= V*P/(0.082*(T+273))
11 m= n*M
12 n2= P1*V/(0.082*(T1+273))
13 m2= n2*M
14 //RESULTS
15 printf ('Initial Mass of Oxygen = %.f gm ',m)
16 printf ('\n Final mass of oxygen= %.f gm ',m2)

```

---

#### Scilab code Exa 9.3 chapter 9 example 3

```

1 clc
2 //initialisation of variables
3 V2= 0.75 //ft^3
4 P2= 1 //atm
5 P1= 3 //atm
6 T= 35 //F
7 e= 1.3
8 //CALCULATIONS
9 V1= ((P2*(V2)^e)/P1)^(1/e)
10 T2= P1*V1*(T+460)/(P2*V2)
11 //RESULTS
12 printf ('Final volume = %.2f ft^3 ',V2)
13 printf ('\n Final temperature= %.f R',T2)
14 //The answer is approximated in the textbook

```

---

#### Scilab code Exa 9.4 chapter 9 example 4

```

1  clc
2  //initialisation of variables
3  m= 0.45 //kg
4  v1= 0.03 //m^3
5  v2= 0.06 //m^3
6  P= 6.9*10^5 //Pa
7  K= 1.4
8  R= 287.1 //J/Kg K
9  //CALCULATIONS
10 T1= (P*v1)/(m*R)
11 T2= T1
12 P2= P*v1/v2
13 T3= T2*(v2/v1)^(K-1)
14 P3= P2*(v2/v1)^K
15 //RESULTS
16 printf ('T1 = %.f K ',T1)
17 printf (' \n T2= %.f K',T2)
18 printf (' \n T3= %.f K',T3)
19 printf (' \n P2= %.2e Pa',P2)
20 printf (' \n P3= %.2e Pa',P3)

```

---

#### Scilab code Exa 9.5 chapter 9 example 5

```

1  clc
2  //initialisation of variables
3  P= 1 //atm
4  T= 60 //F
5  P1= 4 //atm
6  e= 1.3
7  R= 55.15 //lbf/lbm R
8  m= 778
9  //CALCULATIONS
10 T2= (T+460)*(P1/P)^((e-1)/e)
11 W= R*(T2-(T+460))/(1-e)
12 W1= W/m

```

```
13 //RESLUTS
14 printf ('Work associated with the process= %.1f Btu/
    lbm ',W1)
```

---

#### Scilab code Exa 9.6 chapter 9 example 6

```
1 clc
2 //initialisation of variables
3 m= 10 //lbm
4 R= 48.28 //lbf/lbm R
5 T= 120 //F
6 V= 150 //ft^3
7 m1= 15 //lbm
8 R1= 55.15 //lbf/lbm R
9 //CALCULATIONS
10 P1= (m*R*(T+460))/V
11 P2= (m1*R1*(T+460))/V
12 Pm= P1+P2
13 V1= (m*R*(T+460))/Pm
14 V2= (m1*R1*(T+460))/Pm
15 Vm= V1+V2
16 //RESULTS
17 printf ('Total volume= %.f ft^3 ',Vm)
```

---

# Chapter 10

## Combustion Processes

Scilab code Exa 10.1 Chapter 10 example 1

```
1 clc
2 //initialisation of variables
3 n= 3 //lbm mol
4 Mo2= 32 //lbm/lbm mol
5 //CALCULATIONS
6 m= n*Mo2
7 //RESULTS
8 printf ('Mass of O2 required= %.f lbm ',m)
```

---

Scilab code Exa 10.2 chapter 10 example 2

```
1 clc
2 //initialisation of variables
3 n= 3 //lbm mol
4 Mo2= 32 //lbm/lbm mol
5 //CALCULATIONS
6 m= n*Mo2
7 //RESULTS
8 printf ('Mass of O2 required= %.f lbm ',m)
```

---

Scilab code Exa 10.3 chapter 10 example 3

```
1 clc
2 //initialisation of variables
3 n= 12.5 //mol
4 n1= 3.76 //mol
5 M= 114 //gm/gm mol
6 M1= 28.96 //gm/gm mol
7 //CALCULATIONS
8 n2= n*(1+n1)
9 m= n2*M1/M
10 //RESULTS
11 printf ('Air-fuel ratio= %.1f gm air/gm fuel',m)
```

---

Scilab code Exa 10.4 chapter 10 example 4

```
1 clc
2 //initialisation of variables
3 p= 150
4 nO2= 12.5 //mol
5 n1= 3.76
6 //CALCULATIONS
7 n2= (nO2*(p/100))+(nO2*n1*(p/100))
8 //RESULTS
9 printf ('Air-fuel raio= %.2f kg mol air/kg mol fuel',
        ,n2)
```

---

Scilab code Exa 10.5 chapter 10 example 5

```
1 clc
2 //initialisation of variables
3 P= 65
4 T= 30 //C
5 T1= 10 //C
6 c= 4.19 //J/gm C
7 h= 41961
8 m= 185 //lt
9 //CALCULATIONS
10 Q= m*103*c*(T-T1)
11 M= (Q*100)/(h*P)
12 //RESULTS
13 printf ('Benzene required= %.f gm ',M)
```

---

# Chapter 11

## Conduction Heat Transfer

Scilab code Exa 11.1 Chapter 11 example 1

```
1 clc
2 //initialisation of variables
3 T= 76 //F
4 T1= 21 //F
5 Tw= 67 //W
6 h= 1.5 //Btu/
7 A= 1 //ft^2
8 h0= 6.5 //Btu/hr
9 //CALCULATIONS
10 q= h*A*(T-Tw)
11 t= (q/(h0*A))+T1
12 //results
13 printf ('Outside wall temperature= %.1f F',t)
```

---

Scilab code Exa 11.2 chapter 11 example 2

```
1 clc
2 //initialisation of variables
```



```

3 hi= 2 //Btu/hr ft^2 F
4 l= 6 //in
5 k= 0.5 //Btu/hr ft F
6 h0= 10 //Btu/hr ft^2 F
7 ti= 70 //F
8 t0= 20 //F
9 A= 1 //ft^2
10 //CALCULATIONS
11 U= 1/((1/hi)+((l*0.5)/(6*k))+(1/h0))
12 q= U*A*(ti-t0)
13 //RESULTS
14 printf ('Thermal transmittance= %.2f ft^2 F',U)
15 printf ('\n Heat transfer rate= %.1f Btu/hr',q)

```

---

### Scilab code Exa 11.3 chapter 11 example 3

```

1 clc
2 //initialisation of variables
3 Ti= 300 //F
4 T0= 100 //F
5 l= 0.25 //in
6 li= 3 //in
7 A= 12 //in/ft
8 ks= 31.4 //Btu/hr ft F
9 ki= 0.04 //Btu/hr ft F
10 //CALCULATIONS
11 q= (Ti-T0)/((1/(A*ks))+ (li/(A*ki)))
12 t= Ti-((q*l/12)/ks)
13 //RESULTS
14 printf ('Heat loss= %.f Btu/hr',q)
15 printf ('\n Temperature at the interface of the
steel and the insulation= %.2f F',t)

```

---

Scilab code Exa 11.4 chapter 11 example 4

```
1 clc
2 //initialisation of variables
3 ti= 149 //C
4 t0= 27 //C
5 D0= 0.1149 //m
6 l= 1 //m
7 h0= 23 //W/m^2 C
8 hi= 227 //W/m^2 C
9 k= 0.19 //W/m C
10 Di= 0.0889 //cm
11 //CALCULATIONS
12 D1= D0*100
13 D2= Di*100
14 R0=(1/(D0*%pi*l*h0))
15 Rins=(log(D1/D2)/(2*%pi*k*l))
16 Ri=1/(Di*%pi*l*hi)
17 q= (ti-t0)/(R0+Rins+Ri)
18 //RESULTS
19 printf ('Heat loss= %.f W',q)
```

---

Scilab code Exa 11.5 chapter 11 example 5

```
1 clc
2 //initialisation of variables
3 l= 0.2 //m
4 l1= 0.5 //m
5 k= 0.35 //W/m C
6 t= 0.15 //m
7 T1= 1100 //C
8 T2= 150 //C
9 //CALCULATIONS
10 Ai= 6*l^2
11 Ao= 6*l1^2
```

```
12 q= 0.73*k*sqrt(Ai*Ao)*(T1-T2)/t
13 //RESULTS
14 printf ('Power consumption= %.f W',q)
```

---

#### Scilab code Exa 11.6 chapter 11 example 6

```
1 clc
2 //initialisation of variables
3 h= 12 //W/m^2 C
4 k= 0.19 //W/m C
5 d= 0.6 //m
6 //CALCULATIONS
7 r= k/h
8 d1=d/2
9 if (r<d1)
10     printf('heat loss will increase if the
11           insulation is added');
11 else
12     printf('heat loss will increase if the
13           insulation is added');
13 end
```

---

#### Scilab code Exa 11.7 chapter 11 example 7

```
1 clc
2 //initialisation of variables
3 h= 85 //W/m^2 C
4 s= 0.15 //m
5 K= 225 //W/m C
6 t= 510 //C
7 t1= 1200 //C
8 t0= 16 //C
9 a= 0.34
```

```
10 //CALCULATIONS
11 Bi= h*s/K
12 T= K*s*log((t0-t1)/(t-t1))/(h*a)
13 //RESULTS
14 printf ('Time needed for the casting to be heated to
    510 C= %.2f hr ',T)
```

---

# Chapter 12

## Convection Heat Transfer1

Scilab code Exa 12.1 Chapter 12 example 1

```
1  clc
2  //initialisation of variables
3  d= 5 //ft
4  Tw= 150 //F
5  T= 50 //F
6  Pr= 0.72
7  k= 0.015 //Btu/hr ft F
8  r= 1.76*10^6 //(F ft ^3)^-1
9  //CALCULATIONS
10 D= d*(0.42/5)
11 dt= Tw-T
12 Gr= r*D^3*dt
13 z= Gr*Pr
14 h= 0.59*(z^(0.25)) *(k/D)
15 disp(h)
16 q= (2*h*dt*d^2)/144
17 //RESULTS
18 printf ('Heat transfer rate from both sides of the
    plate= %.2f Btu/hr ',q)
19 //The answer given in the textbook has been rounded
    off at several places.
```

20 //Hence it differs from the one in the code.

---

### Scilab code Exa 12.2 chapter 12 example 2

```
1  clc
2  //initialisation of variables
3  T= 70 //F
4  l= 0.9 //in
5  v= 7 //ft/s
6  d= 62.3 //lbm/ft^3
7  m= 6.58*10^-4 //lbm/ft s
8  Pr= 6.82
9  k= 0.347 //Bt/hr ft F
10 //CALCULATIONS
11 l1= l*0.075/l
12 Re= (d*v*l1)/m
13 Nu= 0.023*Re^0.8*Pr^0.4
14 h= Nu*k/l1
15 //RESULTS
16 printf ('Heat transfer coefficient when the flow is
    fully devoloped= %.f Btu/hr ft^2 F',h)
```

---

### Scilab code Exa 12.3 chapter 12 example 3

```
1  clc
2  //initialisation of variables
3  P= 1 //atm
4  d= 0.783 //Kg/m^3
5  K= 0.0371 //W/m C
6  m= 2.48*10^-5 //Ns/m^2
7  Pr= 0.683
8  D= 0.03 //m
9  v= 6 //m/s
```

```

10 T= 10 //C
11 //CALCULATIONS
12 Re= d*v*D/m
13 Nu= 0.023*Re^0.8*Pr^0.4
14 h= Nu*K/D
15 ql= h*%pi*D*T
16 //RESULTS
17 printf ('Heat transfer rate per unit lenght= %.1f W/
    m',ql)

```

---

#### Scilab code Exa 12.4 chapter 12 example 4

```

1 clc
2 //initialisation of variables
3 T= 25 //C
4 P= 1 //atm
5 v= 46 //m/s
6 d= 5 //cm
7 T1= 135 //C
8 d1= 0.998 //kg/m^3
9 k= 0.03 //W/m C
10 m= 2.08*10^-5 //Kg/s m
11 c= 0.024
12 n= 0.81
13 //CALCULATIONS
14 Tf= (T+T1)/2
15 D= d/100
16 Re= d1*v*D/m
17 h= c*Re^0.81*k/D
18 dt= T1-T
19 ql= h*%pi*D*dt
20 //RESULTS
21 printf ('Heat transfer rate per unit lenght of
    cylinder= %.f W/m',ql)

```

---

# Chapter 13

## Boiling Heat Transfer

Scilab code Exa 13.1 Chapter 13 example 1

```
1  clc
2  //initialisation of variables
3  P= 1 //atm
4  dt= 11 //C
5  Csf= 0.006
6  r= 1/3
7  s= 1
8  cl= 4.218 //J/gm K
9  hfg= 2257 //J/gm
10 Pr= 1.75
11 ul= 283.1*10^-3 //gm/m s
12 s= 57.78*10^-3 //N/m
13 pl= 958*10^3 //gm/m^3
14 pv= 598 //gm/m^3
15 gc= 10^3 //gm m/N s^2
16 g= 9.8 //m/s^2
17 //CALCULATIONS
18 p= pl-pv
19 q= (((cl*dt)/(hfg*Csf*Pr))^(1/r))*(ul*hfg)/(gc*s/(
    g*p))^(1/2)
20 h= q/dt
```



```

21 //RESULTS
22 printf ('Heat transfer coefficient for nucleate
    boiling= %.2e W/m^2 C',h)

```

---

Scilab code Exa 13.2 chapter 13 example 2

```

1  clc
2  //initialisation of variables
3  k= 0.384 //Btu/hr ft F
4  Tsat= 170.03 //F
5  hfg= 996.2 //Btu/lbm
6  T= 130 //F
7  l= 5 //ft
8  P= 6 //psia
9  g= 4.17*10^8 //ft/h^2
10 d= 0.042 //ft
11 p= 61.2 //lbm/ft^3
12 u= 1.05 //lbm/ft h
13 //CALCULATIONS
14 dt= Tsat-T
15 Tf= (Tsat+T)/2
16 hc= 0.943*((k^3*p^2*g*hfg)/(l*u*dt))^(1/4)
17 hc1= 0.725*((k^3*p^2*g*hfg)/(d*u*dt))^(1/4)
18 //RESULTS
19 printf ('Condensation heat tranfer coefficient if
    the tube is vertical= %.f Btu/h ft^2 F',hc)
20 printf ('\n Condensation heat tranfer coefficient
    if the tube is horizontally= %.f Btu/h ft^2 F',
    hc1)

```

---

# Chapter 14

## Radiation Heat Transfer

Scilab code Exa 14.2 Chapter 14 example 2

```
1 clc
2 //initialisation of variables
3 T= 116 //C
4 C1= 3.74*10^-16
5 C2= 1.44*10^-2
6 //CALCULATIONS
7 WLmax= (2893*10^-6)/(T+273)
8 Wb= (C1*(WLmax)^(-5))/((%e^(C2/2893*10^6))-1)
9 //RESULTS
10 printf ('Wavelength at which the maximum
    monochromatic emissive power = %.2e m',WLmax)
11 printf ('\n Coffecient of performnace= %.2e W/m^3 '
    ,Wb)
```

---

Scilab code Exa 14.3 chapter 14 example 3

```
1 clc
2 //initialisation of variables
```

```

3 T= 389 //K
4 s= 5.7*10^-8 //K^4
5 //CALCULATIONS
6 Wb= s*T^4
7 //RESULTS
8 printf ('Emissive power for the blackbody = %.f W/m
^2 ',Wb)

```

---

#### Scilab code Exa 14.4 chapter 14 example 4

```

1 clc
2 //initialisation of variables
3 T= 100 //F
4 T1= 2000 //F
5 W= 3.2*10^4 //Btu/hr ft^2
6 W1= 140 //Btu/hr ft^2
7 s= 0.17*10^-8 //Btu/hr ft^2 R^4
8 //CALCULATIONS
9 alpha= W/(s*(T1+460)^4)
10 b= W1/(s*(T+460)^4)
11 //RESULTS
12 printf ('Average absorptivity of the body at 100 F =
%.2f ',alpha)
13 printf ('\n Average absorptivity of the body at
2000 F= %.2f ',b)

```

---

#### Scilab code Exa 14.5 chapter 14 example 5

```

1 clc
2 //initialisation of variables
3 T= 300 //F
4 T1= 50 //F
5 s= 0.17*10^-8 //Btu/hr ft^2 R^4

```

```

6 e1= 0.93
7 A= 10 //in
8 F= 1
9 //CALCULATIONS
10 A1= 10*(40/(12*10))
11 q= A1*F*e1*s*((T+460)^4-(T1+460)^4)
12 //RESULTS
13 printf ('Heat loss from the conduit by radiation = %
        .f Btu/hr per ft ',q)

```

---

#### Scilab code Exa 14.6 chapter 14 example 6

```

1 clc
2 //initialisation of variables
3 T= 300 //F
4 T1= 50 //F
5 s= 0.17*10^-8 //Btu/hr ft^2 R^4
6 e1= 0.93
7 F= 1
8 //CALCULATIONS
9 hr= F*e1*s*((T+460)^4-(T1+460)^4)/(T-T1)
10 //RESULTS
11 printf ('Radiation heat transfer coefficient= %.2f
        Btu/hr ft^2 R',hr)

```

---

#### Scilab code Exa 14.7 chapter 14 example 7

```

1 clc
2 //initialisation of variables
3 P= 1 //atm
4 T= 11 //C
5 Tsat = 170.03
6 Csf= 0.006

```

```

7 r= 1/3
8 s= 1
9 dt = Tsat - T
10 cl= 4.218 //J/gm K
11 hfg= 2257 //J/gm
12 Pr= 1.75
13 ul= 283.1*10^-3 //gm/m s
14 s= 57.78*10^-3 //N/m
15 pl= 958*10^3 //gm/m^3
16 pv= 598 //gm/m^3
17 gc= 10^3 //gm m/N s^2
18 g= 9.8 //m/s^2
19 //CALCULATIONS
20 p= pl-pv
21 q= (((cl*dt)/(hfg*Csf*Pr^s))^(1/r))*(ul*hfg)/(gc/(
    g*p))^(1/2)
22 h= q/T
23 //RESULTS
24 printf ('Heat transfer coefficient for nucleate
    boiling= %.2e W/m^2 C',h)

```

---

# Chapter 15

## Refrigeration and Air Conditioning

Scilab code Exa 15.1 Chapter 15 example 1

```
1 clc
2 //initialisation of variables
3 P= 7 //bar
4 P1= 1.4 //bar
5 T= 260 //C
6 T1= 251 //C
7 h= 2974.9 //J/gm
8 //CALCULATIONS
9 dT= T-T1
10 Mj= dT/(P-P1)
11 //RESULTS
12 printf ( 'Joule-Thomson coefficient= %.2f C/bar ',Mj)
```

---

Scilab code Exa 15.2 chapter 15 example 2

```
1 clc
```

```

2 //initialisation of variables
3 T= 10 //F
4 T1= 110 //F
5 Pr= 180 //lbm/hr
6 h1= 78.335 //Btu/lbm
7 h3= 33.531 //Btu/lbm
8 h2= 91 //Btu/lbm
9 L= 12000 //Btu/hr per ton
10 //CALCULATIONS
11 h4= h3
12 QL= h1-h4
13 W= h2-h1
14 COP= QL/W
15 C= QL*Pr/L
16 //RESULTS
17 printf ('Refrigerating effect = %.1f Btu/lbm ',QL)
18 printf (' \n Coffecient of performnace= %.1f ',COP)
19 printf (' \n Capacity of refrigeration in tons= %.2f
    ton ',C)

```

---