Scilab Textbook Companion for Concise Physics by H. Matyaka[1]

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Book Description

Title: Concise Physics

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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

Basics

Scilab code Exa 1.1 Neutral temperature

```
clc
clear
//input
x=(0:50:550)//temperature difference in x axis
y=[0,0.43,0.79,1.10,1.36,1.54,1.69,1.77,1.80,1.78,1.70,1.54] //emf in y axis
//calculation
title("a graph of E vs teta")//setting title for graph
xlabel("temperature difference teta")//setting x label
ylabel("emf E")//setting y label
plot(x,y)//plotting the graph
printf("from the grapgh it can be determined that neutral temperature is 400deg C")
x=(50:50:550)//temperature difference in x axis
y=[8.6,7.9,7.3,6.8,6.2,5.6,5.1,4.5,4.0,3.4,2.8] //E/theta in y axis
plot(x,y,"+-")//plotting the graph
title("a graph of E/teta vs teta")//set title
```

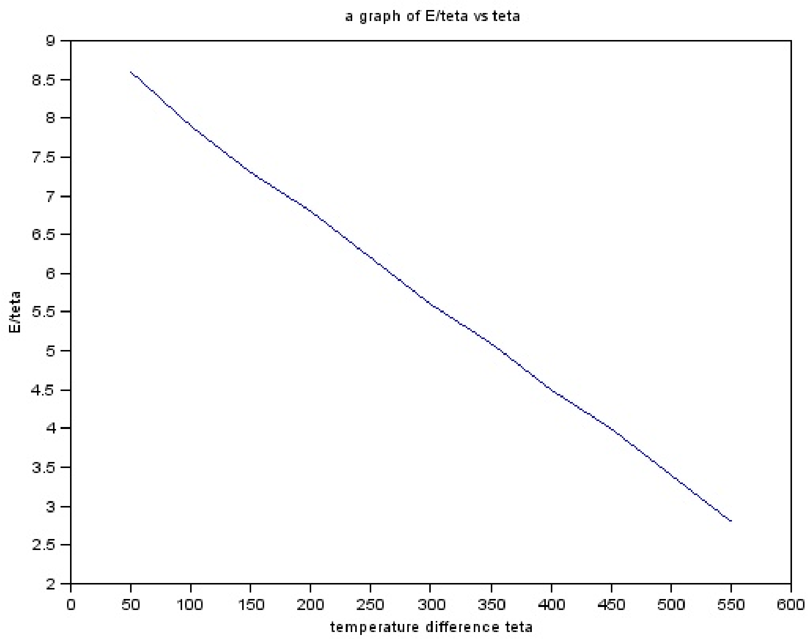

Figure 1.1: Neutral temperature

```
xlabel("temperature difference teta")//set x label
ylabel(" E/teta")//set y label
legend("E Vs Theta","E/theta Vs theta")
b=-(4.5*10^-6)/400//gradient of graph is b
a=4.5*10^-6-(b*400)//finding the intercept on y axis by substututing the points(400,4.5) in line equation
printf("\n the value of b is %3.3e VdegC^-2",b)
printf("\n the value of a is %3.3e VdegC^-1",a)
```

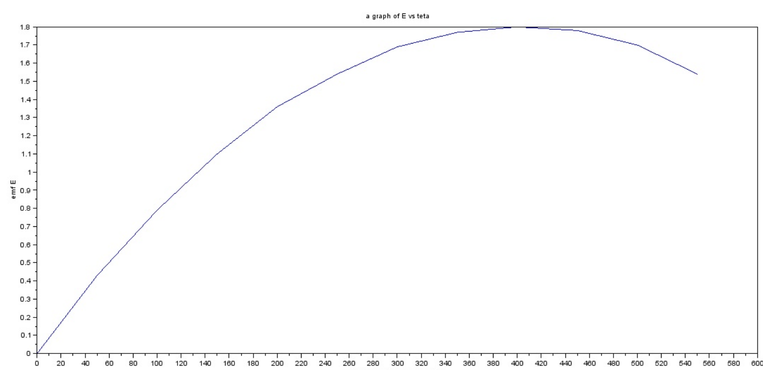

Figure 1.2: Neutral temperature

Chapter 2

Mechanics

Scilab code Exa 2.1 acceleration and distance

```
clc
clear
//input from given graph
//calculation of initial accleration
ia=18/4
// calculation of final accleration
fa=-18/10
decel=-(fa)//calculation of deceleration
//calculation of total distance covered
d=0.5*(4*18)+(8*18)+0.5*(10*18)//area under velocity time graph
//output
printf("\n the initial acceleration is %3.3f m/s^2",ia)
printf("\n the final acceleration is %3.3f m/s^2",decel)
printf("\n the distance covered is is %3.3f m",d)
```

Scilab code Exa 2.2 acceleration and distance

```
clc
clear
//input
v=0 //car stops => final velocity=0
u=29 //initial velocity
t=11 //time
//calculation of acceleration
a=(v-u)/t//eqn of uniformly accelerated body
//calculating distance travelled during this period
d=(v+u)*t*0.5//eqn of uniformly accelerated body
//output
printf("the accleration is %3.3f ms^-2 ",a)
printf("\nthe distance travelled is %3.3f m",d)
```

Scilab code Exa 2.3 time to reach aircraft

```
clc
clear
//input
v=120 //velocity
a=75 //accleration
//calculation of time
t=2*v/(a*cosd(45))//eqn of uniformly accelerated
    body
//output
printf("the time taken is %3.3f s",t)
```

Scilab code Exa 2.4 resultant force

```
clc
clear
//input
f1=50
```

```
f2=50
//calculation of net force
f=f1+f2 // the two forces act in same direction
//output
printf("the resultant force is %3.3f N",f)
```

Scilab code Exa 2.5 car and wind

```
clc
clear
//input
vc=25 //velocity of car
va=10 //velocity of wind
va1=15 //velocity of wind westward
//calculation
v1=vc+va//resultant velocity for a tail of wind
v2=vc-va//when wind blows westward at 10 m/s^
    resultant velocity
v3=vc-va1//resultant velocity when wind blows
    westward at 15m/s^2
//output
printf("1. the resultant velocity of wind is %3.3f
    ms^-1 eastwards ",v1)
printf("\n2. the resultant velocity of wind is %3.3f
     ms^-1 westwards ",v2)
printf("\n3. the resultant velocity of wind is %3.3f
      ms^-1westwards ",v3)
```

Scilab code Exa 2.7 velocity of speedboat

```
clc
clear
//input
```

```
v=30 //velocity of speedboat
vw=40 //velocity of wind
//calculation
x=(30/40)//angle between original velocity of boat
    and resultant velocity
y=atand(x)//applying trigonometry
b=90+y//bearing of boat
//output
printf("the bearing of speedboat is %3.3f deg",b)
```

Scilab code Exa 2.8 tension on string

```
clc
clear
//input
f1=6 //tension on string AB
f2=6 //tension on string BC
//calculation of tension
t=2*f1*sind(55)// the resultant tension is the
    diagonal of rhombus formed
//output
printf("/n the resultant tension is %3.3f N",t)
```

Scilab code Exa 2.10 resultant force

```
clc
clear
//input magnitude of forces
f1=40
f2=50
//calculation
d=50^2+40^2+2*50*40*cosd(50)//finding the diagonal
```

```
r=50^2+40^2+2*50*(40)*cosd(130)//reversing the side and finding diagonlprintf("the resultant is %3.3f",d1)
r1=sqrt(r)//resultant sum
d1=sqrt(d)// resultant when smaller force is subtracted from larger
//output
printf("1. the resultant sum is %3.3f N",d1)
printf("\n 2. the resultant when smaller force is subtracted from larger is %3.3f N",r1)
```

Scilab code Exa 2.11 components of velocity

```
clc
clear
//input
v=380//velocity
//calculation
vh=v*cosd(60)//horizontal component
vv=v*sind(60)//vertical component
//output
printf("the horizontal component is %3.3f ms^-1",vh)
printf("\nthe vertical component is %3.3f ms^-1",vv)
```

Scilab code Exa 2.12 components of force

```
clc
clear
//input
fc=50//force applied by magnet
x=90-20 //angle of force
//calculation
fb=fc*sind(70)//force due to b
```

```
fa=fc*cosd(70)//force due to a
//output
printf("the force due to b is %3.3f N",fb)
printf("\nthe force due to b is %3.3f N",fa)
```

Scilab code Exa 2.13 inelastic collission

```
clc
clear
//input
m1=1
v1=25
m2=2
v2=0
//calculation
v=(m1*v1)+(m2*v2)//applying princilpe of conservation of linear momentum
v4=v/(m1+m2)
//output
printf("the velocity with which both will move is %3.3f ms^-1",v4)
```

Scilab code Exa 2.14 Inelastic collission

```
clc
clear
//input
m1=1//mass of object 1
v1=25//velocity of object 1
m2=2//mass of object 2
v2=0//body at rest,velocity =0
v3=10
//caclulation
```

```
u=((m1*v1)+(m2*v2)-(m2*v3))/2//applying princilpe of
    conservation of linear momentum
//output
printf("\n the value of u is %3.3f ms^-1",-u)
```

Scilab code Exa 2.15 angularvelocity and centripetal force

```
clc
clear
//input
m=2//mass
r=4//radius
v=6//uniform speed
//calculation
w=v/r//angular velocity
f=m*r*w*w//centripetal force
//output
printf("the angular velocity is %3.3f rads^-1",w)
printf("\n the centripetal force is %3.3f N",f)
```

Scilab code Exa 2.16 tension in arm

```
clc
clear
//input
m=140//mass
v=8//speed
r=5//radius
g=9.8//acceleration due to gravity
//calculation
t=((m*v^2/5)^2)+(140*9.8)^2 //applying parallelogram
    of vectors
t1=sqrt(t)
```

```
//output
printf("the tension in arm is %3.3f N",t1)
```

Scilab code Exa 2.17 inclination and reaction

```
clc
clear
//input
v=15//velocity
m=70//mass
r=50//radius
//calculation
x=v*v/(r*10)//applying parallelogram of vectors,then
    for equilibrium
y=atand(x)
r1=(m*10)/cosd(y)
//output
printf("the inclination is %3.3f deg",y)
printf("\n the reaction is %3.3f N",r1)
```

Scilab code Exa 2.18 planet mean density

```
clc
clear
//input
r=5500//radius
g1=6.7*10^-11
g=7//acceleration due to gravity
//calculation of mean density
p=3*g/(4*%pi*r*10^3*g1)//mean density
//output
printf("the mean density of planet is %3.3f kgm^-3",
    p)
```

Scilab code Exa 2.19 orbit radius and linearvelocity

```
clc
clear
//input
m=5*10^24//mass of earth
g1=6.7*10^-11
//calculation
r=((6.7*10^-11*5*10^24*(3600*24)^2)/(4*%pi^2))^(1/3) //orbit radius
v=(2*%pi*r)/(3600*24)//linear velocity
//output
printf("the orbit radius is %3.3f",r)
printf("\n the linear velocity is %3.3f ms^-1",v)
```

Scilab code Exa 2.20 mass of galaxy

```
clc
clear
//input
v=3*10^5//orbit speed
r=4.6*10^20//distance
g1=6.7*10^-11
//calculation of mass
m=v*v*r/g1 //Newtons law
//output
printf("the mass is %2.3e kg",m)
```

Scilab code Exa 2.21 total kinetic energy

```
clc
clear
//input
v=0.6//speed
m=0.3//mass
//calculation
e=0.75*m*v*v//total kinetic energy is kinetic energy
   +moment of inertia
//output
printf("the total kinetic energy is %3.3f J",e)
```

Scilab code Exa 2.22 time taken to move

```
clc
clear
//input
t1=34
u=0//starts from rest
x=3//distance to move
//calculation
t=(3*3/(10*sind(t1)))^0.5//from law of conservation
    of energy
//output
printf("the time taken is %3.3f s",t)
```

Scilab code Exa 2.23 angular velocity ratio

```
clc
clear
//input
i1=53//inertia when it spins with panels carrying
    solar cells
i2=37//inertia about axis of rotation
```

```
//calculation
r=i1/i2//law of conservation of angular momentum
//output
printf("the ratio of angular velocities is %3.3f",r)
```

Scilab code Exa 2.25 attributes of shm

```
clc
clear
//input
f=9//frequency
x=0//at midpoint of stroke x=0
//calculation
t=1/f
a=-4*%pi^2*f^2*x//acceleration for shm
v=2*%pi*f*0.05//velocity for shm
a1=-4*%pi^2*9^2*0.05//acceleration at amplitude
v1=0//velocity at amplitude is 0
//output
printf("the period of oscillation is %3.3f s^-1",t)
printf("\n the velocity  at midpoint of stroke is %3.3f ms^-1",v)
printf("\n the acceleration at midpoint of stroke is %3.3f ms^-2",a)

printf("\n the velocity at amplitude is %3.3f  ms^-1",v1)
printf("\n the acceleration at amplitude is %3.3f ms^-2",a1)
```

Scilab code Exa 2.26 simple harmonic motion

```
clc
```

```
clear
//input
g=10
t=0.3//period of shm
//calculation
x=g*t^2/(4*%pi^2)//for shm maximum amplitude
//output
printf("the maximum amplitude for bead to be in
    contact is %3.3f m",x)
```

Scilab code Exa 2.27 attrbutes simple pendulum

```
clc
clear
//input
p1=2.3//period of pendulum
p2=3.1//period when pendulum is lengthened
//calculation
g=4*%pi^2/(p2^2-p1^2)//acceleration of free fall
l=p1^2*g/(4*%pi^2)//length of pendulum
//output
printf("the acceleration of free fall is %3.3f m/s^2
    ",g)
printf("\n the length of pendulum is %3.3f m",l)
```

Scilab code Exa 2.28 maximum displacement shm

```
clc
clear
//INPUT DATA
f=55 //frequency
a=7*10^-3 //amplitude

```

```
//calculation
a=(-2*%pi*f)^2*a

//output
printf("the acceleration of the body when it is at
    its maximum displacement from its zero position
    is -%3.1f ms^-2",a)
```

Scilab code Exa 2.29 maximum potential energy shm

```
clc
clear
//input
f=55//frequency
amp=7*10^-3//amplitude
m=1.2//mass
//calculation
e=0.5*m*4*%pi^2*f^2*amp^2//maximum pe occurs at zero
     position
//output
printf("the maximum pe is %3.3f J",e)
```

Scilab code Exa 2.30 extension of steel wire

```
clc
clear
//input
l=6.5//length
m=0.06//mass of wire
m1=10//mass attached
g=9.8//acceleration due to gravity
e=2.1*10^11//youngs modulus
```

```
ro=8*10^3//density of steel
//calculation
e1=m1*g*ro*l*l/(e*m)//extension caused
pe=0.5*g*m1*e1//potential energy
//output
printf("the extension caused is %3.3e m",e1)
printf("\n the potential energy is %3.3f J",pe)
```

Scilab code Exa 2.31 Youngs modulus

```
clc
clear
//input
w=250*10^3
s=0.00003//strain
a=0.04//area
w1=320*10^3
//calculation
e=w/(a*s)//youngs module
st=w1/a//stress
//output
printf("the youngs modulus is %3.3e N/m^2",e)
printf("\n the stress is %3.0e N/m^2",st)
```

Scilab code Exa 2.32 wire length change

```
clc
clear
//input
m=40//mass
g=9.8//acceleration due to gravity
E=2*10^11//youngs modulus
//calculation
```

```
t1=m*g/5//principle of momentum
t2=4*m*g/5 //principle of momentum
d=4*(t2-t1)/(4*%pi*10^-6*E)//difference in length
//output
printf("the difference is %3.0e m",d)
```

Chapter 3

Waves

Scilab code Exa 3.1 refraction and incidence angle

```
clc
clear
//calculation of angle of refraction
rj=(sind(6)/0.76)//from snells law
x=asind(rj)
printf("the refractive index of jelly is %3.3f deg",
   x)
// calculating angle of incidence
printf("\nsince angle of refraction and angle of
   incidence are alternate angles , angle of
   incidence is %3.3f deg",x)
//calculating angle of refraction
np=0.59/0.76 // according to relationship of media
jnp=sind(7.9)/0.78
rp=asind(jnp)
printf("\nthe angle of refraction  is %3.3f deg",rp)
```

Scilab code Exa 3.2 critical angle

```
clc
clear
//input data
a=1.28 //refractive index of X
b=1.41 //refractive index of Y
//calculation of condition for total internal reflection
x=(a/b)
c=asind(x) // calculating critical angle
//output
printf("light incident with an angle greater than %3.3f degrees will be totally internally reflected",c)
```

Scilab code Exa 3.3 wavespeed in medium

```
clc
clear
//input data
nb=0.67 //refractive index
va=3.45*10^3
//calculation
vb=va/nb //snells law
//output
printf("the speed of the wave in medium b is %3.3f m/s",vb)
```

Scilab code Exa 3.4 frequency for antinode

```
clc
clear
//input data
f=120 //lowest frequency
```

```
//calculation
x=3*f // the next higher frequency is thrice the lowest frequency
//output
printf("the next higher frequency where the antinode is formed is at %3.3f Hz",x)
```

Scilab code Exa 3.5 wave frequency speed

```
clc
clear
//input data
amp=3.4*10^-5 //amplitude of the wave
af=5.7*10^2 //angular frequency
k=20 //wavenumber
//calculation
//wave frequency
f=af/(2*%pi)
l=(2*%pi)/k
v=f*l
printf("the wave frequency is %3.3f and the speed is %3.3f  m/s",f,v)
//calculating greatest speed for the wave to pass through
vmax=af*amp //greatest speed
//output
printf("\nthe greatest value of speed for the wave to pass through is %3.3f m/s",vmax)
```

Scilab code Exa 3.6 wave attributes

```
clc
clear
```

```
//input
k=16
w=23
//calculation
//1.wavelength
l=2*%pi/k
//output
printf("the wavelength is %3.3f m",l)
//2.wavespeed
v=(l*w)/(2*%pi)
printf("\nthe wavespeed is %3.3f m/s",v)
//3.pase difference
pha=(0.5*2*%pi)/0.39 // phase difference of
    molecules 0.5m apart
printf("\n the phase difference is %3.3f radians",
    pha)
```

Chapter 4

Waves

Scilab code Exa 4.1 amplitude and pressure change

```
clc
clear
//INPUT DATA
w=1.8 //wavelength
//calulation
y=sind(15*360/180)//displacement at 15cm from
   reflector
//output
printf("1. at 45cm, antinode occurs and hence
   pressure is minimum")
printf("\n 2. at 90cm node arises and hence pressure
    is maximum")
printf("\n 3. at 15cm frm reflector the displacement
    is %3.3f",y)
```

Scilab code Exa 4.3 length of tube

```
clc
```

```
clear
//INPUT DATA
f=520 //frequency
t2=293 //air temperature to produce fundamental +273
t1=273// 0deg C
v1=330//speed of sound waves
//calculation
v2=330*(293/273)^0.5 //speed at 20 deg C
l=v2/f//wavelength
len=l/4 - 0.01 //length
//output
printf("the length of tube is %3.3f m",len)
```

Scilab code Exa 4.4 frequency of beats

```
clc
clear
//INPUT DATA
v1=330 //speed of sound
t3=303 //fundamental temperature for the air
t1=273// 0deg C
//calculation
v3=v1*(t3/t1)^0.5 //new speed of sound
f=v3/0.66 //frequency
fb=f-520 //frequency of beats
//output
printf("the frequency of beats is %3.3f Hz",fb)
```

Scilab code Exa 4.5 fundamental frequency

```
clc
clear
//INPUT DATA
```

```
T=100 //tension
l=1.5 //length
m=0.3*10^-6 //mass
//calculation
f=(T/(m/l))^0.5/(2*l)//fundamental frequency
   produced
//output
printf("the fundamental frequency produced is %3.3f
   Hz",f)
```

Scilab code Exa 4.6 doppler effect

```
clc
clear
//INPUT DATA
f=150 //frequency
v=320 //speed of sound
ul=11 //speed with which listener approaches
us=7 //speed of source
//calculation
fa=f*v/(v-us)//doppler effect
fa1=(v+ul)*f/(v)//doppler effect
fa2=(v+ul)*f/(v-us)//doppler effect
//output
printf("frequency when source moves at 7ms^-1 %3.3f
   Hz",fa)

printf("\n frequency when listener moves at 11ms^-1
   %3.3f Hz",fa1)
printf("\n frequency when source moves at 7ms^-1 and
    listener at 11ms^-1 %3.3f Hz",fa2)
```

Scilab code Exa 4.7 apparent frequency change

```
clc
clear
//INPUT DATA
us=264 //speed of jet fighter
x=71.7
v=340 //velocity of sound
f=1*10^3 //frequency
//calculation
usd=us*cosd(x)//horizontal component of velocity
fr= (v*f)/(v-usd) -((v*f)/(v+usd))//frequency range
    ,doppler effect
//output
printf("the frequency range is %3.3f Hz ",fr)
```

Chapter 5

Light

Scilab code Exa 5.1 minimum deviation

```
clc
clear
//INPUT DATA
np=1.39 //refractive index of prism
nl=1.29 //refractive index of liquid
a=62 //refracting angle of prism
//calculation
x=np*sind(62/2)/nl//snells law
y=asind(x)
d=(y*2)-a//minimum deviation
//output
printf("the minimum deviation is %3.3f degree",d)
```

Scilab code Exa 5.2 incidence and prism angle

```
clc
clear
//INPUT DATA
```

```
np=1.39 //refractive index in air
a=62 //refracting angle of prism
//calculation
x=1/np
c=asind(x)//critical angle
r=a-c
i= np* sind(r)//snells law
i1=asind(i)
A=2*c//greatest prism angle allowing refraction
//output
printf("angle of incidence producing maximum
   deviation is %3.3f deg",r)
printf(" \n greatest prism angle allowing refraction
    is %3.3f deg",A)
```

Scilab code Exa 5.3 position and nature of image

```
clc
clear
//input
f=0.15 //focal length
u=0.2 //distance of object
//calculation
x=(1/-f)-(1/u)//lens formula
y=1/x
m=y/u//linear magnification
//output
printf("the position of image is %3.3f m",y)
printf("\n linear magnification is %3.3f hence image
    is diminished",m)
```

Scilab code Exa 5.4 position of image

```
clc
clear
//input
f1=0.25 //focal length of diverging lens
f2=0.2 //focal length of converging lens
//calculation
x=(1/-f1)+(1/f2)//lens formula
y=1/x
a=(1/y)-(1/0.15)//lens formula
b=1/a
//output
printf("the position of image is %3.3f m hence the image is virtual",b)
```

Scilab code Exa 5.5 position and nature of image

```
clc
clear
//input
f=0.5 //focal length
u=0.8 //distance of object
f1=0.2 //focal length of converging lens
d=1 //distance behind the first lens
//calculation
x=(1/f)-(1/u)//lens formula
y=1/x
u1=-(y-d)//second lens
a=1/f1 +(1/-u1)//lens formula
b=1/a
//output
printf("the image lies %3.3f m behind second lens",b)
printf("\n the image is %3.3f  m behind first lens",b+d)
```

Scilab code Exa 5.6 lens values

```
clc
clear
//input
F=5 //power of lenses
f1=0.45 //focal length
//calculation
x=F-(1/f1)//lens formula
f2=1/x
//output
printf("the focal length is %3.3f m",f2)
printf("\n the power is %3.3f dioptre",x)
```

Chapter 6

Heat

Scilab code Exa 6.1 heat given out

```
clc
clear
//input
m=0.5 //mass
c=460 //specific heat capacity of iron
t1=70//initial temperature
t2=10//final temperature
//calculation
q=m*c*(t1-t2)//heat required
//output
printf("the heat required is %3.0f J",q)
```

Scilab code Exa 6.2 potential difference heater

```
clc
clear
//input
T=100 //rise in temperature
```

```
i=2.7 //current
t=950 //time taken
mc=0.15//mass of calorimeter
cy=3*10^3//specific heat capacity of y
cc=2*10^3//specific heat capacity of calorimeter
my=160*10^-3//mass of liquid
//calculation
v=((my*cy)+(mc*cc))*T/(i*t)//law of conservation of heat
//output
printf("the potential difference is %3.0f V",v)
```

Scilab code Exa 6.3 heat loss and specific heat

```
clc
clear
//input
iw=4.5 //current
vw=5.2 //pd of water
mw=6*10^-2 //flow of water
cw=4.18*10^3 //heat capacity of water
ix=5.5//current of x
iv=7.7//pd of x
im=18*10^-2//flow of x
//calculation
x=(iw*vw)-((mw*cw*5)/60)//rate of heat loss
cx=(6*4180)/18 +1263//specific heat capacity of x
//output
printf("the rate of heat loss is %3.3f W",x)
printf("\n the specific heat of x is %3.3e Jkg^-1K^-1",cx)
```

Scilab code Exa 6.4 Boyles law

```
 clc
clear
//input
v1=0.52 //volume of ideal gas
p1=2.3*10^5 //pressure of ideal gas
p2=6.7*10^5 //pressure changed
//calculation
v2=p1*v1/p2//boyle's law
//output
printf("the volume is %3.3f m^3",v2)
```

Scilab code Exa 6.5 Charles law

```
clc
clear
//input
v2=11.3 //final volume
v1=7.8//initial volume
t1=67+273 //initial temperature
//calculation
t2=v2*t1/v1//charles law
//output
printf("the final temperature is %3.0d K",t2)
```

Scilab code Exa 6.6 pressure law

```
clc
clear
//input
p1=1.01*10^5//initial pressure
t2=135+273//final temperature
t1=273//initial temperature
d=2.8 //density
```

```
//calculation
p2=p1*t2/t1//pressure law
p=(3*p2/2.8)^0.5//kinetic theory
//output
printf("rms speed of gas molecule is %3.0f m/s",p)
```

Scilab code Exa 6.7 KE and rms velocity

```
clc
clear
//input
t1=273//initial tenperature
t2=408//final temperature
//calculation
e=t1/t2//ratio of mean molecuar KE
c1=402*sqrt(0.67)//rms speed
//output
printf("the ratio of kinetic energy is %3.3f",e)
printf("\n the rms speed of gas molecule is %3.0f
    ms^-1",c1)
```

Scilab code Exa 6.8 ideal gas equation

```
clc
clear
//input
p=1.01*10^7 //pressure of gas
v=0.1 //volume of gas
R=8.3
T=280//temperature
g=0.017//mass of 1 mole
d=1100//density
//calculation
```

```
n=p*v/(R*T)//ideal gas equation
m=n*g//mass of gas
v=m/d//volume occupied
//output
printf("the volume is %3.3e m^3",v)
```

Scilab code Exa 6.9 Boyles law

```
clc
clear
//input
p1=9*10^4//total pressure
x=1*10^4//water pressure
//calculation
p2=(p1-x)/2//boyles law
p=p2+x//adding vapour pressure
//output
printf("the final pressure is %3.0e Pa",p)
```

Scilab code Exa 6.10 gas external work

```
clc
clear
//input
m=3*10^-2 //mass of water
r1=1*10^3//density of water
r2=0.5//density of steam
p=1.01*10^5//atmospheric pressure
//calculation
v1=m/r1//volume of water
v2=m/r2//volume of gas
w=(v2-v1)*p//external work done by gas
//output
```

```
printf("the work done is %3.0f J",w)
```

Scilab code Exa 6.12 platinum resistance theromoeter

```
clc
clear
//input
r100=6.9//resistence of steam
r0=5.8 //resistece of ice
t=550 //temperature
//calculation
r=(t*(r100-r0))/100 +5.8//platinum resistance thermometre
//output
printf("the resistence is %3.3f ohm",r)
```

Scilab code Exa 6.14 length at temperature

```
clc
clear
//input
l=11.7//length of thermometer at steam
l0=3.4*10^-2//length of thermometer at ice
//calculation
x=0.034+0.034*(0.244*10^-3*45^2)//length of temperature on standard scale
//output
printf("thread length is %3.3f m",x)
```

Scilab code Exa 6.15 heat transfer rate

```
clc
clear
//input
a=5 //area
k=0.07 //thermal conductivity
dt=21 //temperature difference
x= 4*10^-3 //thickness of wood
//calculation
y=-(k*a*dt/x)//steady state equation
//output
printf("the rate of transfer is %3.3f Js^-1",y)
```

Scilab code Exa 6.16 temperature gradient

```
clc
clear
//input
d=3*10^-3//thickness of sheet
l=12*10^-3//seperated distance
//calculation
x=1/40//law of conservation of energy
y=x*d/l//from x
//output
printf("the ratio of temperature gradient in rubber
    to polystyrene is %3.3f0",x)
printf("\nthe ratio of temperature difference across
     rubber and polystyrene is %3.3e",y)
```

Chapter 7

Electricity

Scilab code Exa 7.1 Electric potential strength

```
clc
clear
//input
e=1.6*10^-19 //charge of electron
r=0.075*10^-3 // radius of electron
ep=8.85*10^-12 //permittivity of free space
//calculation
v=-e/(4*%pi*ep*r)//electric potential
e=-e/(4*%pi*ep*r*r)//electric field strength
//output
printf("resultant potential is %3.3e V",v)
printf("\n resultant electric field strength %3.3f V
    /m",e)
```

Scilab code Exa 7.2 ratio of force

```
clc
clear
```

```
//input
q=2.4*10^-19 //charge1
Q=3.8*10^-19//charge2
ep=8.85*10^-12//permittivity of free space
G=6.7*10^-11
m=8.9*10^-31//mass 1
M=1.5*10^-30//mass 2
//calculation
x=q*Q/(4*%pi*ep*m*M*G)//coulumbs law
//output
printf("the ratio of electrostatic force between
    charges %3.3e",x)
```

Scilab code Exa 7.3 emf and internal resistance

```
clc
clear
//input
i=0.5 //current in circuit
R=6 //resistance of circuit
i1=0.3//dropped current
//calculation
r=1.2/0.2
e=i*(r+R)//ohms law
//output
printf("the battery emf is %3.3f V",e)
printf("\n the internal resistence is %3.3f ohm",r)
```

Scilab code Exa 7.4 power output

```
clc
clear
//input
```

```
d=8.2*10^-7 //resistivity of coil
l=15 //length of wire
r=0.3*10^-3 //radius of wires
v=160 //power output
//calculations
R=d*l/(%pi*r*r)
p=v*v/R //for one coil
p1=v*v/(R+R) //for two coils in series
rp=(R*R)/(R+R)//total resistence
pp=(v*v)/rp//total power
//output
printf("the power when one coil is %3.3f W",p)
printf("\nthe power when two coils in series is %3.3f W",p1)
printf("\n the power when coils in parallel is %3.3f W",pp)
```

Scilab code Exa 7.5 percent of pd

```
clc
clear
//input
r1=40//resistance 1
r2=20//resistamce 2
r3=10//resistance 3
v=1.6//voltage
//calculation
R=r1+r2+r3//total resistance in series
x=((v*r1)*70)/((2*50)*(1.6*40))//fraction of pd
x=x*100//percentage pd
//output
printf("the percentage of pd is %3.0f percent",x)
```

Scilab code Exa 7.6 final resistance calculation

```
clc
clear
//input
a=4.3*10^-3//temperature co-efficient of resistance
//calculation
r2=((60*a+1)/(20*a+1))*10//resistance
//output
printf("the final resistence is %3.3f ohm",r2)
```

Scilab code Exa 7.7 internal resistance calculation

```
clc
clear
//input
l1=82.3//balance length  with switch open
l2=75.8//balance length with switch closed
R=9//resistance
//calculation
r=(R*l1/l2)-R//internal resistance
//output
printf("the internal resistence is %3.3f ohm",r)
```

Scilab code Exa 7.8 calculation of resistance

```
clc
clear
//input
p=2*10^-6//pd across wire
v=1.5//voltage
l=1.5*10^3//length of potentiometer
R=7//resistance
```

```
//calculation
vw=p*l//pd across the wire
x=(7*v/vw)-R//resistace of x
//output
printf("the resistance of x is %3.0f ohm",x)
```

Chapter 8

Magnetisn and ac theroy

Scilab code Exa 8.1 force on field

```
clc
clear
//input
B=4.3*10^-4//magnetic flux density
I=6.4//current
L=4.8//length of wire
t=24//inclination through the field
//calculation
f=B*I*L//force on wire when it is perpendicular
f1=B*I*L*sind(t)//force on wire when it is inclined
    at t degrees
//output
printf("the force on wire is %3.3f N",f)
printf("\nthe force at an anglr 24 deg is %3.3e N",
    f1)
```

Scilab code Exa 8.2 flux density

```
clc
clear
//input
i=3.4 //current passing
a=0.04 //distance from centre of cconductor
//calcution
b=(4*%pi*10^-7*5)/(2*%pi*a)//magnetic flux density
//output
printf("the flux density is %3.3e T",b)
```

Scilab code Exa 8.4 permeability of free space

```
clc
clear
//INPUT DATA
Ix=1 //current in first wire
Iy=1 //current in second wire
FbyL=2*10^-7 //according to the definition of ampere
a=1 //distance between the wires


//calculation

m=(2*%pi*a*FbyL)/(Ix*Iy)



//output
printf("the permeability of free space is %3.3e H/m
    ",m)
```

Scilab code Exa 8.5 faraday law

```
clc
clear
//input
n=10 //number of rounds
B=2*10^-2 //flux density
a=5*10^-4 //areaof cross section
t=10//time
//calculation
c=n*B*a //change in flux
emf=c/t //induced emf
//output
printf("the flux changed is  %3.3e Wb ",c)
printf("\n the induced emf is %3.3e V",emf)
```

Scilab code Exa 8.6 moment of couple

```
clc
clear
//input
N=250 //number of turns
B=8.6*10^-4 //flux density
I=5 //current
A=16*10^-4//area
t=35
//calculation
c=B*I*A*N*sind(t)//moment of couple
x=c/(B*I*2*A*N)//doubling the area
y=asind(x)
//output
printf("the moment of couple is %3.3e Nm",c)
printf("\n the new angle produced  is %3.3f deg",y)
```

Scilab code Exa 8.7 maximum emf power

```
clc
clear
//input
a=20*10^-4 //area
n=900 //number of turns
b=5*10^-2 //flux density
i=4.5 //current
//calculation
e=b*a*n*2*%pi*30//emf induced
p=e*i//power output
//output
printf("the emf induced is %3.3f V",e)
printf("\n the power output is %3.3f W",p)
```

Scilab code Exa 8.8 pd across motor

```
clc
clear
//input
R=68 //resistence
i=4.5 //current
e=17 //emf
//calculation
v=(i*R)+e//supply pd
//output
printf("the supply of pd across motor is %3.0f V",v)
```

Scilab code Exa 8.9 transformer equation

```
clc
clear
//input
ns=330 //number of turns of secondary
```

```
np=450 //number of turns in primary
e=0.65 //efficiency
vp=240 //ac supply of primary
//calculation
vs=e*(vp*ns)/np//transformer equation
//output
printf("the pd across secondary is %3.0f V",vs)
```

Scilab code Exa 8.10 power loss ratio

```
clc
clear
//input
v=15*10^3 //voltage
p=80*10^3 //power
r=430 //resistence
v1=150*10^3//stepped value
//calculation
i=p/v//cable current
i1=p/v1//stepped up cable current
k=i*i/(i1*i1)//ratio of power loss
//output
printf("the ratio of power loss is %d",k)
```

Scilab code Exa 8.11 secondary power output

```
clc
clear
//input
ep=150*10^3 //electric energy to primary
e=0.69 //efficieny
t=70 //time
//calculation
```

```
es=e*ep//transformer equation
ps=es/t//power
//output
printf("the power output is %3.3e W",ps)
```

Scilab code Exa 8.12 charge produced

```
clc
clear
//input
v=250 //dc voltage
s=0.22 //length
d=4*10^-3 //diameter
//calculation
q=8.9*10^-12*1*0.22*0.22*250/(4*10^-3)//for air
q1=8.9*10^-12*6.8*0.22*0.22*250/(4*10^-3)//for
    material
//output
printf("the permittivity  for air is %3.3e C",q)
printf("\n the relative permittivity for material is
     %3.3e C",q1)
```

Scilab code Exa 8.13 relative permittivity

```
clc
clear
//input
d=6*10^-5
w=0.1
er=9.4 //relative permittivity of medium
c=1*10^-6 //capacitance
//calculation
```

```
l=c*d/(8.9*10^-12*er*w)//parallel plate capacitor formula
//output
printf("the length of wax paper is %3.3f m",l)
```

Scilab code Exa 8.14 charge in capacitors

```
clc
clear
//input
v=3 //voltage
c1=2.5*10^-6 //capacitance
c2=2.5*10^-6
c3=2.5*10^-6
//calculation
q=v/((1/c1)+(1/c2)+(1/c3))//capacitors in series
q1=c1*v//capacitors in parallel
//output
printf("the pd when capacitors are in series is %3.3e C",q)
printf("\n the pd when capacitors are in parallel is %3.3e C",q1)
```

Scilab code Exa 8.15 rms and peak voltage

```
clc
clear
//input
v=14 //voltage
//calculation
v0=v*sqrt(2)//rms value
//output
printf("rms value of ac is 14 V")
```

```
printf("\n the peak value of ac is %3.3f V",v0)
```

Scilab code Exa 8.16 Qmax and rms current

```
clc
clear
//input
c=65*10^-6 //capcacitor
v=12 //voltage
f=90 //frequency
//calculation
vmax=v*sqrt(2)//peak pd
qmax=c*vmax//from eqn Q=CV
irms=v*2*%pi*f*c//maximum charge from capacitor
    reactance
//output
printf("the maximum charge is %3.3f A",irms)
```

Scilab code Exa 8.17 capacitance of C

```
clc
clear
//input
r=200 //resistence
v=14 //voltage
vr=9//pd across each component
f=90 //frequency
//calculation
c=vr/(2*%pi*f*vr*r)//capacitor connected
//output
printf("the capacitor connected is %3.3e F",c)
```

Scilab code Exa 8.18 rate of change of pd

```
clc
clear
//input
v=4 //voltage
r=200 //resistence
c=8.8*10^-6 //capacitance
//calculation
x=v/(r*c)//calculating V/t
//output
printf("the initial rate is %3.3e Vs^-1",x)
```

Scilab code Exa 8.19 determine resistance and capacitance

```
clc
clear
//input
v=14 //voltage
f=90 //frequency
i=0.4 //current
t=55 //phase
//calculation
r=v/(i*sqrt(1+tand(t)^2))// value of resistance
l=r*tand(t)/(2*f*%pi)//value of inductance
c=1/(4*%pi*%pi*f*f*l)//value of capacitance for
   resonance to occur
//output
printf("the value of resistance is %3.3f ohm",r)
printf("\nthe value of inductance is %3.3f H",l)
printf("\nthe value of capacitor is %3.3e F",c)
```

Chapter 9

The Atom

Scilab code Exa 9.1 electric field effect

```
clc
clear
//input
v=400 //voltage
d=0.18 //distance of screen from centre
e=1.6*10^-19 //electronic charge
m=9.1*10^-31 //mass
l=0.03 //length of parallel plates
s=0.01 //air gap
//calculation
w=e*v//work done
v1=sqrt(2*e*v/m)//speed of electron
e1=v/s//electric field strength
d1=d*6*10^3*l/(2*v)//vertical displacement
//output
printf("the work done is %3.3e J",w)
printf("\n the speed of electron is %3.3e ms^-1",v1)
printf("\n the displacement is %3.3f m",d1)
```

Scilab code Exa 9.2 Millikan experiment

```
clc
clear
//input
v=5.7*10^-4 //velocity
ro=830 //density
d=4*10^-3
V=3.2*10^3 //pd
g=9.8 //acceleration due to gravity
k=4.2*10^-4 //resistive force of air
//calculation
r=sqrt(3*k*v/(4*%pi*ro*g))//equating the forces on
   drop
q=4*%pi*r^3*ro*g/(3*V/d)//electric firld between
   plates
//output
printf("the radius of oil drop is %3.3e m",r)
printf("\n the value of electric firld between
   plates is %3.3e C",q)
```

Scilab code Exa 9.3 Stephan Boltzmann law

```
clc
clear
//input
sig=6//stephans constant
//calculation
x=3^4*6*2^2/6//ratio of rate of emission
//output
printf("the ratio of rate of emission is %d and
   hence larger cube emits faster than smaller",x)
```

Scilab code Exa 9.4 working temperature

```
clc
clear
//input
p=900 //power
d=4*10^-3 //diameter
l=0.87//length
sig=5.7*10^-8 //stephans constant
//calculation
t=(p/(%pi*d*l*sig))^0.25//temperature
//output
printf("the working temperature is %d K",t)
```

Scilab code Exa 9.5 stephan law

```
clc
clear
//input
e1=350//heat per second
t=7+273 //teperature
sig=5.7*10^-8//stephans constant
//calculation
e2=e1*4//stephans law
E=sig*(t^4-t^4)//stephans law
//output
printf("the rate of emission is %3.3f W",e2)
printf("\nthe rate of emission when outer
   temperature is increased is %d W",E)
```

Scilab code Exa 9.6 incereased temperature effect

```
clc
```

```
clear
//input
t1=280
t2=290//temperature of surroundings
sig=5.7*10^-8 //stephans constant
//calculation
e3=sig*(t1^4-t2^4)//stephans law
e1=6.2*10^9*sig
e3=0.15*e1
//output
printf("the absorbing rate is %d W",e3)
```

Scilab code Exa 9.7 plancks theory

```
clc
clear
//input
c=3*10^8 //velocity of speed
w=5.1*10^-7 //wavelength of green light
w1=0.7 //wavelength of radio waves
w2=1.3*10^-13 //wavelength of gamma
h=6.6*10^-34
//calculation
e1=h*c/w//plancks theory for greeen light
e2=h*c/w1//plancks theory for radio waves
e3=h*c/w2//plancks theory for gamma waves
//output
printf("energy carried by green light is %3.3e J",e1)
printf("\nenergy carried by radio waves is %3.3e J",e2)
printf("\nenergy carried by gamma waves is %3.3e J",e3)
```

Scilab code Exa 9.8 quantities of metal

```
clc
clear
//input
c=3*10^8//speed of light
m=9.1*10^-31//mass of electron
tw=5.12*10^-7//threshhold wavelength
w1=4.52*10^-8 //radiation wavelength
h=6.6*10^-34//stephans constant
//calculation
f0=c/tw//threshhold frequency
w=h*f0//work function
a=h*c/w1//einsteins photo electric equation
v=sqrt((2*(a-w))/m)//photoelectric energy
emax=0.5*m*v*v
//output
printf("threshhold frequency is %3.3e Hz",f0)
printf("\n the work function is %3.3e J",w)
printf("\n the maximum photoelectric speed is %3.3e
    ms^-1",v)
printf("\n the maximum photoelectric energy is %3.3e
    J",emax)
```

Scilab code Exa 9.9 decay law

```
clc
clear
//input
t=2.14*10^6*365*24*60*60//half time
//calculation
l=0.693/t//decay constant
```

```
t1=1.1097/l//decay law
t2=t1/(365*60*60*24)//time in yrs
//output
printf("time taken is %3.3e yrs",t2)
```

Scilab code Exa 9.10 count rate determination

```
clc
clear
//input
w=0.004//weight of manganese
a=6*10^23
t=303*24*3600//half time
//calculation
N=w*a/0.054//number of moles
x=0.693*N/(303*24*3600)//count rate from decay law
//output
printf("the count rate is %3.3e counts per second",x
   )
```

Scilab code Exa 9.11 determination of attributes

```
clc
clear
//input
v=400//pd
d=4*10^-3 //distance of seperation
B=0.52//flux density
na=6*10^23//avagadro number
//calcuation
E=v/d//electric field strength
v1=E/B// speed of ions
m=24*10^-3/na//mass of each ion
```

```
ke=m*v1*v1/2//kinetic energy
W=1.6*10^-19*1
KE=ke/W//kinetic energy in electron volts
//output
printf("the electric field strength is %3.3e Vm^-1",
   E)
printf("\n the speed of ions is %3.3e m/s",v1)
printf("\n the kinetic energy is %3.3e J",ke)
printf("\n the kinetic energy in electron volts is
   %3.3f ev",KE)
```

Scilab code Exa 9.12 velocity selection

```
clc
clear
//input
v=400//pd
d=4*10^-3 //distance of seperation
B=0.52//flux density
na=6*10^23//avagadro number
//calculation
x=2*1.6*10^-19/(4*10^-26)//specific charge of ions
r=1*10^5/(8*10^6*B*B)// path radius
//output
printf("the specific charge of ions is %3.0e C/kg",x
   )
printf("\n the path radius is %3.3e m",r)
```

Chapter 10

Physical Optics

Scilab code Exa 10.1 plancks theory

```
clc
clear
//input
h=6.6*10^-34 //plancks constant
c=3*10^8 //velocity of light
e1=12.34//excited state
e2=14.19//ground state
//calculation
l=(h*c)/((e2-e1)*1.6*10^-19)//conservation of energy
    and plancks theory
//output
printf("the wavelength is %3.3e m",l)
```

Scilab code Exa 10.2 wavelength and prism angle

```
clc
clear
//input
```

```
la=0.535*10^-6//wavelength
nb=1.51//refractive index
dmin=34 //minimum deviation
//calculation
l=la/nb//wavelength of light
x=(nb-cosd(dmin/2))/sind(dmin/2)//refractive index
    of prism
y=acotd(x)
z=y*2
//output
printf("the wavelength of light is %3.3e m",l)
printf("\nthe angle of prism is %3.0d deg",z)
```

Scilab code Exa 10.3 thin film interference

```
clc
clear
//input
n=7//order of fringe
l=0.63*10^-6 //wavelength
x=24.8*10^-3 //seperation of bands
d=1.5
//calculation
a=n*d*l/x//slit seperation
//output
printf("the slit seperation is %3.3e m",a)
```

Scilab code Exa 10.4 fringe width determination

```
clc
clear
//input
n=6//order of fringe
```

```
l=0.63*10^-6 //wavelength
x=24.8*10^-3 //seperation of bands
d=1.5
a=2.7*10^-4
//calculation
x=d*(6+1/2)*l/a//distance between centre and sixth
    fringe
w=l*1.6/a//fringe width
//output
printf("the distance between centre and sixth fringe
    is %3.3e m",x)
printf("\nthe fringe width is %3.3e m",w)
```

Scilab code Exa 10.5 increasing thickness effect

```
clc
clear
//input
a=4//widge dimension
b=64//edge of tissue
c=33//bright fringes
l=0.53*10^-6 //wavelength
//calculation
m=b*c/a//number of bright fringes
t=m*l/2//thickness
//output
printf("the thickness is %3.3e m and hence number of
    fringes also increases",t)
```

Scilab code Exa 10.6 wavelength and angular displacement

```
clc
clear
```

```
//input
n1=6//6th order image
n2=5//5th order image
n=3000//lines per cm
//calculation
l=n2*0.11*10^-6/(6-5)//applying dsinx=nl
l1=l+(0.11*10^-6)//applying dsinx=nl
d=1/(n*100)//applying dsinx=nl ,grating space
    calculation
x=n1*l/d
y=asind(x)
//output
printf("the wavenlength of first wave is %3.3e m",l)
printf("\nthe wavenlength of second wave is %3.3e m"
    ,l1)
printf("\n the angular displacement is %3.3f deg",y)
```

Scilab code Exa 10.7 wavelength and diffraction angle

```
clc
clear
//input
n2=1.36//refractive index
N=5000*100 //number of lines per m
t=23 //angle of diffraction
//calculation
l=sind(t)/(n2*N)//applying dsinx=nl,calculating
    wavelength
x=N*l//angle of diffraction
y=asind(x)
//output
printf("the wavelength of light in methanol is %3.3e
    m",l)
printf("\n the angle of diffraction is %3.3f degrees
    ",y)
```

Scilab code Exa 10.8 telescope angular magnification

```
clc
clear
//input
fo=1.5//objective's focal length
fc=0.04//eyepiece focal length
//calculation
m=fo/fc//angular magnification
v=fc*(fc+fo)/fo//distance of eye ring from eyepiece
//output
printf("the angular magnification is %3.2f",m)
printf("\n the distance of eye ring from eyepiece is
    %3.3f m",v)
```

Chapter 11

Semiconductors

Scilab code Exa 11.1 rms current and peak pd

```
clc
clear
//input
vp=50//ac source supply
r1=35
r2=1450 //resistors
//calculation
vs=4*vp//transformer equation
i=100/(r1+r2)//peak current
irms=i/sqrt(2)//rms current
v0=100*r1/(r1+r2)
pp=100-v0//peak pd
//output
printf("the rms value of current is %3.3f A",irms)
printf("\n the peak pd is %3.3f V",pp)
```

Scilab code Exa 11.2 common emittor transistor

```
clc
clear
//input
vbe=1.2//pd across emitter
ib=120*10^-6//base current
v1=1.5//final voltafe
i2=175*10^-6//increased current
//calculation
r=vbe/ib//static input resistence
h=(v1-vbe)/(i2-ib)//input hybrid parameter
//output
printf("the static input resistence is %3.0e ohm",r)
printf("\nthe input hybrid parameter is %3.3e ohm",h
   )
```

Scilab code Exa 11.3 common base transistor

```
clc
clear
//input
v1=7.5//initial voltag
v2=11.5//final voltage
ic=18*10^-6//collector current
//calculation
r=(v2-v1)/ic//output resistance
//output
printf("the output resistance is %2.2e ohm ",r)
```

Scilab code Exa 11.4 common emittor amplifier

```
clc
clear
//input
```

```
vbe=2.5//voltage across base-emitter
hfe=75//current gain
rb=75*10^3 //base current
//calculation
rc=5*rb/(vbe*hfe)//collector load resistance
//output
printf("the collector load resistance is %2.2e ohm",
   rc)
```