R Textbook Companion for A Textbook of Electrical Engineering Materials by P. L. Kapoor[1]

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Book Description

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R 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)

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

Contents

List of R Codes

Chapter 2

Conducting Materials

R code Exa 2.1 Calculate the resistance

```
# Page No : 21

l = 300.0
a = 25*(10^-6)
d15 = 2.7
R15 = d15*(l/a)
print(R15)
k0 = 0.004
t = 15;
T = 50
k15 = k0/(1+(k0*t))
R50 = R15*(1+k15*(T-t))
print(R50)

# The answer provided in the textbook is wrong.
```

R code Exa 2.2 Calculate the resistance

```
# Page No : 21

R20  =  400
k0  =  0.0038
t  =  20
T = 80
k1 = k0/(1+(k0*t))
R80 = R20*(1+k1*(T-t))
print(R80)
```

R code Exa 2.3 What will be the temprature

```
# Page no : 22

t = 15
R15 = 250
RT = 300.0
k0 = 0.0038
k1 = k0/(1+(k0*t))
T = (((RT/R15)-1)/k1)+t
print(T)
```

R code Exa 2.4 Calculate length of a heater element

```
# Page NO : 22

d  =  0.4*(10^-3)
a  =  pi*(d^2)/4
p1  =  100*(10^-8)
R  =  40
l1  =  R*a/p1
print(l1)
d  =  0.4*(10^-3)
```

```
a  =  12.6*(10^-8)
p2  =  1.72*(10^-8)
R  =  40
l2  =  R*a/p2
print(l2)

# The answer may slightly vary due to rounding off
   values.
```

R code Exa 2.5 Find the resistance

```
# Page No : 23

R0  =  80
t  =  40
k0  =  0.0043
R40  =  R0*(1+(k0*t))
print(R40)
```

R code Exa 2.6 Find the temprature

```
# Page Number :  23

R80 = 50
R28 = 40
t = 28
T = 80
k28 = ((R80/R28)-1)/(T-t)
print(k28)
k0 = k28/(1-k28*t)
print(k0)
```

R code Exa 2.7 Calculate the resistance

```
# Page Number :  24

l = 1000
d = 0.09/100
p = 1.724*(10^-8)
a = pi*(d^2)/4
R = p*l/a
print(R)

# The answer may slightly vary due to rounding off
   values.
```

R code Exa 2.8 Calculate the resistance

```
# Page Number :  24

R20 = 50
T = 60
t = 20
k0 = 0.00427
R0 = R20/(1+(k0*t))
print(R0)
R60 = R0*(1+(k0*T))
print(R60)
```

R code Exa 2.9 Find the resistivity

```
# Page Number :  24

k20 = 1/254.5
p0 = 1.6*(10^-6)
t = 20
T = 50
k0 = k20/(1-(t*k20))
p50 = p0*(1+(T*k0))
k50 = 1/(T+(1/k0))
print(k0)
print(p50)
```

R code Exa 2.10 Determine the Temprature

```
# Page Number :  25

R15 = 50
RT = 58
t = 15
k0 = 0.00425
R0 = R15/(1+(k0*t))
T = ((RT/R0)-1)/k0
print(R0)
print(T)

# The answer may slightly vary due to rounding off
    values.
```

R code Exa 2.11 Determine the Temprature

```
# Page Number :  25

R25 = 50
```

```
4 R70 = 57.2
5 t = 25
6 T = 70
7 k0 = (R70-R25)/((R25*T)-(R70*t))
8 print(k0 )
```

R code Exa 2.12 Find its percentage conductivity

```
1 # Page Number : 26
2
3 R0 = 15.5
4 t = 16
5 k0 = 0.00428
6 R16 = R0*(1+(k0*t))
7 G = (R0/R16)*100
8 print(R16)
9 print(G)
```

R code Exa 2.13 Find its temprature

```
1 # Page Number : 26
2
3 RT = 144
4 R20 = 10
5 t = 20
6 k20 = 5*(10^-3)
7 T = (((RT/R20)-1)/k20)+t
8 print(T)
```

R code Exa 2.14 Find the mean temprature

```
# Page Number :  27

V15 = 250
Vt = 250
I15 = 5
It = 4
T = 15
R15 = V15/I15
print(R15)
Rt = Vt/It
print(Rt)
k0 = 0.0038
R0 = R15/(1+(k0*T))
print(R0)
t = ((Rt/R0)-1)/k0
print(t)
```

R code Exa 2.15 Calculate the resistance

```
# Page Number :  28

n = 100
c = 12
Lm = 300
a = 1.5*0.2
s = 1.72*(10^-6)
p = 4
t = 20
T = 75
k0 = 0.00427
L = n*c*Lm
Ls = L/p
s0 = s*(1-(k0*t))
print(s0)
RT = (s0*Ls)/a
```

```
17 print(RT)
```

R code Exa 2.16 Estimate its resistance

```
1 # Page Number :  28
2
3 a = 15
4 l = 100000
5 p0 = 7.6*(10^-6)
6 k0 = 0.005
7 t = 50
8 p50 = p0*(1+(t*k0))
9 R50 = p50*(l/a)
10 print(R50)
```

R code Exa 2.17 Estimate the fusing

```
1 # Page Number :  29
2
3 I2 = 27.5
4 d = 1/2
5 I1 = I2*(d^(3/2))
6 print(I1)
```

R code Exa 2.18 Compare the diameter

```
1 # Page Number :  30
2
3 sAl = 2.85*(10^-6)
4 sCu = 1.7*(10^-6)
```

```
gAl = 2.71
gCu = 8.89
cAl = 5000
cCu = 10000
Kd = sqrt(sAl/sCu)
print(Kd)
Km = (Kd^2)*(gAl/gCu)
print(Km)
Kc = Km*(cAl/cCu)
print(Kc)
```

R code Exa 2.19 Find the resistance

```
# Page Number :  33

R1 = 18.6
Kl = 5
Ka = 3
R2 = R1*Kl/Ka
print(R2)
```

R code Exa 2.20 Determine the heat efficiency

```
# Page Number :  57

m = 1
S = 4200
T2 = 100
T1 = 15
H = m*S*(T2-T1)
print(H)
W = 500
t = 15*60
```

```
Hd = W*t
print(Hd)
He = (H/Hd)*100
print(He)
```

R code Exa 2.21 What is the time taken

```
# Page Number :  58

m = 3.6
S = 4200
T2 = 95
T1 = 15
H = m*S*(T2-T1)
print(H)
e = 0.84
Ei = H/e
print(Ei)
W = 1000
t = (Ei/W)/60
print(t)

# The answer may slightly vary due to rounding off
   values.
```

Chapter 4

Insulating Materials

R code Exa 4.1 Find the capacity of each condenser

```
# Page Number :  110
library(polynom)
p = polynomial(c(0.0048, -0.16, 1))
c1 = solve(p)[1]
print(c1)
c2 = 0.16-c1
print(c2)
```

R code Exa 4.2 Calculate the capacitance

```
# Page Number :  110
n = 9;
Ko = 8.854*10^-12;
K = 5;
A = 12*10^-4;
d = 2*10^-4;
C = (n-1)*Ko*K*A/d
print(C);
```

```
9
10 # The answer provided in the textbook is wrong.
```

R code Exa 4.3 Find the heat produced

```
1 # Page Number :  110
2
3 C = 10^-6
4 V = 10000
5 E = 1/2*C*V^2
6 H = E/4.2
7 print(H)
```

R code Exa 4.4 Calculate the dielectric constant

```
1 # Page Number :  111
2
3 A = 0.02;
4 d = 0.001;
5 C = 4.5*10^-10;
6 Ko = 8.854*10^-12;
7 K = (C*d)/(Ko*A)
8 V = 15000;
9 Q = C*V
10 D = Q/A
11 print(D)
```

R code Exa 4.5 Find K2

```
1 # Page Number :  111
```

```
2
3 d = 0.003;
4 K1 = 6;
5 Ko = 8.854*10^-12;
6 d1 = 0.003;
7 d2 = 0.005;
8 K2 =  (d2*K1)/(3*d-d1)
9 print(K2)
```

R code Exa 4.6 Determine the force

```
1 # Page Number :  113
2
3 q1 = 1;
4 q2 = 1;
5 Eo = 8.854*10^-12;
6 Er = 1;
7 d = 1
8 pi = 3.14;
9 F = (q1*q2)/(4*pi*Eo*Er*d^2)
10 print(F)
11
12 # The answer may slightly vary due to rounding off
     values.
```

R code Exa 4.7 Find the charge on each

```
1 # Page Number :  114
2
3 pi = 3.14;
4 d = 0.2;
5 K = 9*10^9;
6 F = 9.81*10^-1;
```

```
7 q = sqrt((F*(d^2))/K)
8 print(q)
```

Chapter 5

Dielectric Materials

R code Exa 5.1 Calculate its charge and capacity

```
1 # Page Number :  193
2
3 t = 0.25
4 I = 0.22
5 V = 220
6 Q = I*t
7 C = Q/V
8 C1 = C*(10^6)
9 print(Q)
10 print(C)
11 print(C1)
```

R code Exa 5.2 Calculate the charge on each plate

```
1 # Page Number :  193
2
3 C = 0.0002*(10^-6)
4 V = 20000
```

```
t = 2
Q = C*V
g = (V/t)*(1/1000)
print(Q)
print(g)
```

R code Exa 5.3 Find the energy stored

```
# Page Number :  194

C = 0.005*(10^-6)
V = 500
q = C*V
E = (1/2)*(C*V*V)
print(q)
print(E)
K = 2.5
q1 = q
C1 = K*C
E1 = (q1^2)/(2*C1)
print(E1)
```

R code Exa 5.4 Calculate the dielectric constant

```
# Page Number :  194

A = 0.02
d = 0.001
C = 4.5*(10^-10)
V = 15000
K0 = 8.854*(10^-12)
K = (C*d)/(K0*A)
q = C*V
```

```
10 D = q/A
11 print(K)
12 print(D)
```

R code Exa 5.5 Calculate the capacitance

```
1 # Page Number :  195
2
3 A = 0.2
4 t = 2.5*(10^-5)
5 K0 = 8.854*(10^-12)
6 K = 5
7 C = (K*K0*A*(10^6))/t
8 print(C)
```

Chapter 6

Magnetic Materials

R code Exa 6.1 Determine the current required

```
# Page Number :  212

f = 0.01
l = 1
N = 1000
Ur = 1000
Uo = 4*pi*(10^-7)
a = 0.001
I = (f*l)/(N*Uo*Ur*a)
print(I)
```

R code Exa 6.2 Find the relative permeability

```
# Page Number :  212

f = 1.2*(10^-3)
l = 1.4
N = 500
```

```
Uo = 4*pi*(10^-7)
a = 0.0012
I = 2
Ur = (f*l)/(N*I*Uo*a)
print(Ur)
```

R code Exa 6.3 Determine the flux Density

```
# Page Number :  213

l = 0.4
N = 200
Uo = 4*pi*(10^-7)
a = 5*(10^-4)
I = 6.4
f = 0.8*(10^-3)
fd = f/a
fi = I*N/l
Ur = (f*l)/(N*I*Uo*a)
print(fd)
print(fi)
print(Ur)

# The answer provided in the textbook is wrong.
```

R code Exa 6.4 Calculate the energy lost

```
# Page Number :  214

Hl = 250
V = 1/150
N = 50
E = Hl*V*N
```

```
Eh = (E*3600)/1000
print(Eh)
```

R code Exa 6.5 Determine the core loss

```
# Page Number :  214

P = 4
N = 1600
f = P*N/120
V = 5400
d = 7.5
m = (V*d)/1000
L = 1.76
Cl = L*m
print(f)
print(Cl)
```

R code Exa 6.6 Determine the core loss

```
# Page Number :  214

v = 76300
P = 8
N = 375
f = P*N/120
Bmax = 12000
n = 0.002
d = 7.8
l = 1.7
Hl = n*v*f*(Bmax^1.6)*(10^-7)
Al = v*d*l/1000
Tl = Hl+Al
```

```
14 print(Tl)
```

R code Exa 6.7 Find the loss of energy

```
1  # Page Number :  215
2
3  m = 12000
4  d = 7.5
5  Hl = 3000
6  N = 50
7  v = m/d
8  E = v*Hl*N
9  Eh = E/(10^10)
10 print(Eh)
```

R code Exa 6.8 Separate the loss

```
1  # Page Number :  215
2
3  m = 10
4  T1 = 20
5  f1 = 50
6  T2 = 35
7  f2 = 75
8  c2 = (T2-(T1*f2/f1))/(f2^2-f1*f2)
9  c1 = (T1-c2*f1^2)/f1
10 k = c1/c2
11 H50 = T1*k/101
12 E50 = T1-H50
13 print(H50)
14 print(E50)
```

Chapter 15

Miscellaneous Solved Numerical Problems

R code Exa 15.1 Calculate the Consumer voltage

```
# Page Number :  392

R = 0.2
I = 200
t = 100
V = 240
c = 0.8
V1 = I*R
Vc = V-V1
P = I*I*R
E = P*t/1000
C = E*c
print(Vc)
print(C)
```

R code Exa 15.2 Find the resistance

```
# Page Number :  393

Vi = 220
Vo = 200
I = 40
Pi = Vi*I
Po = Vo*I
L = Pi-Po
R = L/(I^2)
t = 10
N = (Po*t)/1000
Nw = (L*t)/1000
print(R)
print(N)
print(Nw)
```

R code Exa 15.3 Calculate the current drawn

```
# Page Number :  393

M = 250000
h = 50
g = 9.81
WD = M*h*g
P = WD/3600
V = 500
Ep = 0.8
Em = 0.9
E = Em*Ep
I = P/(V*E)
print(I)
```

R code Exa 15.4 Calculate the torque

```
# Page Number :  394

P = 10
N = 600
a = 75
b = 735.5
Tkgm = (P*a*60)/(2*pi*N)
TNwm = (P*b*60)/(2*pi*N)
print(Tkgm)
print(TNwm)
```

R code Exa 15.5 Calculate the mass of oil

```
# Page Number :  395

P = 25
s = 12500
e = 0.35
P1 = P/e
P2 = P1*860
m = P2/s
w = 1000
Eg = (P*w)/m
print(m)
print(Eg)
```

R code Exa 15.10 Determine the resistance

```
# Page Number :  398

rho = 1.7*(10^-6)
l = 5
t = 0.005
```

```
D = 0.08
d = D-(2*t)
a = pi*(D^2-d^2)/4
R = rho*l/a
R1 = R/(10^-4)
print(R1)
```

R code Exa 15.11 Determine the conductivity

```
# Page Number :  399

rho = 1.7*(10^-8)
K = 1/rho
a = 0.125*(10^-4)
l = 2000
G = K*a/l
print(K)
print(G)
```

R code Exa 15.12 Determine the resistivity

```
# Page Number :  399

V = 0.05
l = 300
R = 0.0306
rho = R*V/(l^2)
print(rho)
```

R code Exa 15.13 Calculate the value

```
# Page Number : 400

rho = 0.67*(10^-6)
m = 39.4
m2 = 1525
rhoc = rho*m/m2
rho1 = rhoc/(10^-6)
print(rhoc)
print(rho1)
```

R code Exa 15.14 What is the resistance of new wire

```
# Page Number : 400

R1 = 0.12
d1 = 15
d2 = 0.4*d1
a1 = pi*(d1^2)/4
a2 = pi*(d2^2)/4
R2 = R1*((a1/a2)^2)
print(R2)
```

R code Exa 15.15 what will be the resistance

```
# Page Number : 401

lab = 10
Aab = 1/2
RHOab = 1/2
Ra = 2
Rb = (Ra*Aab)/(lab*RHOab)
print(Rb)
```

R code Exa 15.16 what will be the resistance

```
# Page Number :  402
RHOo = 10.3*(10^-6)
d = 0.0074
a = pi*(d^2)/4
Ro = 4
l = Ro*a/RHOo
alphao = 0.0038
t = 100
R100 = Ro*(1+(alphao*t))
print(l)
print(R100)

# The answer provided in the textbook is wrong.
```

R code Exa 15.17 What is the resistance

```
# Page Number :  403

Ra = 1
lab = 20
Aab = 1/3
Rb = Ra*(Aab/lab)
print(Rb)
```

R code Exa 15.19 Obtain the potential Difference

```
# Page Number :  405
```

```
2
3 I1 = 2/(2+3)
4 Vbe = 3*I1
5 I2 = 4/(5+3)
6 Vaf = 3*I2
7 V = Vbe+4-Vaf
8 print(V)
```

R code Exa 15.20 Find the current

```
1 # Page Number : 405
2 a = matrix(c(1,-1,25,15), nrow=2, byrow=TRUE)
3 b = c(20,1950)
4 I = solve(a,b)[2]
5 print(I)
```

R code Exa 15.21 Determine the herstesis power

```
1 # Page Number : 407
2
3 A = 30
4 s1 = 0.4
5 s2 = 400
6 V = 1.2*(10^-3)
7 f = 50
8 H = A*s1*s2
9 Hp = H*V*f
10 print(Hp)
```

R code Exa 15.22 Find the loss of energy

```
# Page Number :  407

d = 7500
w = 12
V = w/d
f = 25
N = 3600*f
A = 300
E = A*V*N
print(E)
```

R code Exa 15.23 Find the inductance

```
# Page Number :  407

l = 0.5
d = 0.1
N = 1500
a = pi*(d^2)/4
Ur = 1
Uo = 4*pi*(10^-7)
I = 8
L = ((N^2)*a*Uo*Ur)/l
E = (1/2)*L*(I^2)
print(L)
print(E)

# The answer may slightly vary due to rounding off
   values.
```

R code Exa 15.24 Calculate the flux passing

```
# Page Number :  408
```

```
2
3 N = 600
4 I = 2
5 l = 0.6
6 H = N*I/l
7 Ur = 1
8 Uo = 4*pi*(10^-7)
9 d = 0.025
10 a = pi*(d^2)/4
11 phi = Uo*Ur*H*a
12 print(H)
13 print(phi)
```

R code Exa 15.25 Calculate the ampere turns

```
1 # Page Number : 408
2
3 Ur = 1
4 B = 1.257
5 Uo = 4*pi*(10^-7)
6 H = B/(Uo*Ur)
7 l = 0.004
8 AT = H*l
9 print(AT)
10
11 # The answer may slightly vary due to rounding off
    values.
```

R code Exa 15.26 What is the flux through it

```
1 # Page Number : 409
2
3 D = 0.3
```

```
l = pi*D
N = 400
a = 0.0012
Ur = 1000
Uo = 4*pi*(10^-7)
I = 2
phi = (N*I)/(l/(Uo*Ur*a))
phi1 = phi/(10^-3)
print(phi1)
```

R code Exa 15.27 Calculate the magnetising current

```
# Page Number :  409

a = 0.01
Uo = 4*(pi)*(10^-7)
lf = 1.25
Ur = 400
N = 175
phig = 0.8*(10^-3)
Bg = phig/a
Hg = Bg/Uo
Lg = 0.004
ATg = Hg*Lg
phii = phig*lf
Bi = phii/a
Hi = Bi/(Uo*Ur)
Li = 1.5
ATi = Hi*Li
AT = ATi+ATg
I = ATg/N
print(I)
```

R code Exa 15.28 Calculate its charge and capacity

```
# Page Number :  411

SI = 0.2
t = 0.2
Q = SI*t
V = 220
C = Q/V
C1 = C*(10^6)
print(Q)
print(C1)
```

R code Exa 15.29 Find the heat produced

```
# Page Number :  411

C = 2*(10^-6)
V = 10000
E = (1/2)*C*(V^2)
H = E/4.2
print(H)
```

R code Exa 15.30 Calculate the dielectric constant

```
# Page Number :  411

V = 15*(10^3)
A = 0.02
d = 0.001
C = 4.5*(10^-10)
Ko = 8.854*(10^-12)
K = (C*d)/(Ko*A)
```

```
q = C*V
D = q/A
print(q)
print(D)
```

R code Exa 15.31 Calculate the resistance

```
# Page Number :  412

m = 0.6
S = 4200
T1 = 100
T2 = 10
t = 5*60
V = 230
H = m*S*(T1-T2)
e = 0.78
Ei = H/e
Ei1 = Ei/(100*3600)
W = Ei/t
R = (V*V)/W
print(R)
```

R code Exa 15.32 How long will it take

```
# Page Number :  413

m1 = 120
m2 = 20
S1 = 1
S2 = 0.095
T1 = 10
T2 = 60
```

```
H = (m1*S1*(T2-T1))+(m2*S2*(T2-T1))
H1 = H*4200
e = 0.8
E = H1/e
E1 = E/(1000*3600)
r = 3
t = E1/r
print(t)
```

R code Exa 15.33 Determine the frequency of supply

```
# Page Number : 414

rho = 5*(10^-5)
U = 1
d = 0.15
f = (rho*(10^9))/(U*d*d*4*(pi^2))
f1 = f/1000
print(f1)
```

R code Exa 15.34 Determine the power required

```
# Page Number : 414

v = 50*20*2
Mw = 0.56
m = Mw*v/1000
S = 0.35
t = 15/60
f = 30*(10^6)
t2 = 150
t1 = 30
H = m*S*(t2-t1)
```

```
Hw = H*1000/860
P = Hw/t
e = 0.5
Pi = P/e
Ko = 8.854*(10^-12)
K = 5
A = 0.5*0.2
i = 0.02
C = Ko*K*A/i
Xc = 1/(2*pi*f*C)
cosx = 0.05
tanx = 19.97
R = Xc*tanx
V = sqrt(Pi*R)
Ic = V/Xc
print(Pi)
print(V)
print(Ic)
```

R code Exa 15.35 Estimate the efficiency

```
# Page Number :  416

m = 2
t1 = 15
t2 = 660
S = 0.212
L = 78.8
H = (m*S*(t2-t1))+(m*L)
i = 5
E = i*(1000*10*60)
E1 = E/4180
e = H*100/E1
print(e)

```

```
15 # The answer may slightly vary due to rounding off
     values.
```

R code Exa 15.36 Find the cost of using the motor

```
1  # Page Number :  417
2
3  O = 5*735.5
4  e = 0.85
5  c = 2
6  I = O/e
7  t = 4
8  E = I*t/1000
9  C = c*E
10 print(C)
11
12 # The answer may slightly vary due to rounding off
     values.
```

R code Exa 15.37 How many electrons pass through

```
1 # Page Number :  417
2
3 I = 2.5*(10^-3)
4 t = 30*(10^-3)
5 Q = I*t
6 e = 1.602*(10^-19)
7 N = Q/e
8 print(N)
```

R code Exa 15.38 Find the resistance

```
# Page Number :  417

l = 1
a = 2.5*(10^-2)*0.05*(10^-2)
rho = 1.724*(10^-8)
R = rho*l/a
l1 = 0.05*(10^-2)
a1 = 2.5*(10^-2)*1
R1 = rho*l1/a1
print(R)
print(R1)
```

R code Exa 15.39 Calculate the resistance

```
# Page Number :  418

m = 2
t2 = 98
t1 = 15
s = 1
V = 200
H = m*s*(t2-t1)
H1 = H*4200
e = 0.85
E = H1/e
E1 = E/(1000*3600)
c = 35
C = c*E1
t = 10/60
W = E1*1000/t
R = V*V/W
print(R)
print(C)
```

```
20
21 # The answer may slightly vary due to rounding off
       values.
```

R code Exa 15.40 Calculate the value of exciting current

```
1  # Page Number :  418
2
3  phi = 70000/(10^8)
4  d = 0.03
5  a = pi*d*d/4
6  B = phi/a
7  Lg = 0.002
8  Ls = (pi*0.2)-Lg
9  Uo = 4*pi*(10^-7)
10 Ur = 800
11 Hg = B/Uo
12 Hs = B/(Uo*Ur)
13 AT = (Hg*Lg)+(Hs*Ls)
14 N = 500
15 I = AT/N
16 print(I)
```