Scilab Textbook Companion for Solid State Pulse Circuits by D. A. Bell[1]

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Book Description

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

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

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

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

Contents

List of Scilab Codes

Chapter 1

Pulse Fundamentals

Scilab code Exa 1.1 Duty cycle

```
//Caption:Find (a)Pulse amplitude (b)PRF (c)PW (d)
   Duty cycle and (e)M/S ratio
//Exa:1.1
clc;
clear;
close;
v=1//Vertical scale(Volt per division)
h=0.1//Horizontal scale(Milli sec per division)
pv=3.5//Amplitude of pulse in divisions
t=6//Time in divisions
pw=2.5//Width of pulse
P=pv*v
disp(P,'(a)Pulse Amplitude (in volts)=')
T=t*h
prf=(1/T)*1000
disp(prf,'(b)PRF(in pps)=')
p=pw*h
disp(p,'(c)PW (in ms)=')
sw=pv*h
d=(p/T)*100
disp(d,'(d)Duty cycle(in %)=')
```

```
m=p/sw
disp(m,'(e)M/S ratio=')
```

Scilab code Exa 1.2 pulse amplitude

```
//Caption:Determine (a)Pulse amplitude,tilt ,rise
   time,fall time,PW,PRF,mark to space ratio,and
   duty cycle (b)tilt
//Ex1.2
clc;
clear;
close;
vs=100//Vertical scale(in mv/divisions)
hs=100//Horizontal scale(in micro sec/division)
e1=380//first peak of waveform(in mv)
e2=350//second peak of waveform(in mv)
E=(e1+e2)/2
t=(e1-e2)*100/E
tr=0.3*hs
tf=0.4*hs
T=5*hs
prf=10^6/T
pw=2.2*hs
sw=2.8*hs
ms=pw/sw
dc=(pw*100)/T
disp(dc,ms,pw,prf,tf,tr,t,E,'(a)Pulse Amplitude(in
   mv),tilt(in %),rise time(in micro sec),fall time(
   in micro sec),PW(in micro sec),PRF(in pps),M/s
   ratio,Duty cycle(in %)=')
eb=0.5*vs
ee=2.25*vs
tb=eb*100/ee
disp(tb,'(b)Tilt(in %)=')
```

Scilab code Exa 1.3 Average voltage level

```
//Caption:Determine average voltage level
//Ex1.3
clc;
clear;
close;
vs=2//Vertical scale(V/div)
hs=1//Horizontal scale(ms/div)
v1=8//Amplitude of signal in (+)ve direction (in volts)
v2=-1//Amplitude of signal in (-)ve direction (in volts)
t1=0.8//Horizontal divisions for v1
t2=2.2//Horizontal divisions for v2
T=3*hs
T1=t1*hs
T2=t2*hs
Va=((T1*v1)+(T2*v2))/T
disp(Va,'Average voltage (in volts)=')
```

Scilab code Exa 1.4 Determine the upper 3db frequency of the amplifier

```
//Caption:Determine the upper 3db frequency of the amplifier
//Ex1.4
clc;
clear;
close;
tr=1//Rise time(in micro sec)
fu=0.35*10^6/tr
```

```
disp(fu,'The upper 3db frequency of the amplifier(in
    hertz)=')
```

Scilab code Exa 1.5 Determine Minimum upper cut frequency Minimum pulse width and

```
//Caption:Determine (a)Minimum upper cut frequency (
   b)Minimum pulse width and duty cycle
//Ex1.5
clc;
clear;
close;
prf=1.5//in Khz
dc=3//Duty cycle(in %)
pa=1.5//Amplitude of pulse(in Khz)
fu=1//High frequency limit(in Mhz)
tr=10//Rise time(in %)
pw=(dc/100)*10^3/pa
Tr=(tr/100)*pw
fh=0.35*10^6/Tr
disp(fh,'(a)Minimum upper cut frequency(in hertz)=')
Tr2=0.35*10^(-6)/fu
Pw=10*Tr2
dc=Pw*100*(pa*1000)
disp(dc,Pw,'(b)Pulse width(in sec) and Duty cycle(in
    %)=')
```

Scilab code Exa 1.6 Calculate Rise time in output waveform and Minimum upper cut o

```
//Caption:Calculate a. Rise time in output waveform
   b. Minimum upper cut off frequency and displayed
   rise time
//Ex1.6
clc;
```

```
clear;
close;
tr=10//Rise time of input waveform(in micro sec)
fu=350//Upper cut off frequency(in KHz)
ti=100//Input rise time(in ns)
trc=0.35*(10^(-3))/350
tro=sqrt(((tr)*(10^(-6)))^2+(trc^2))*10^6
disp(tro,'(a)Rise Time(in Micro sec)=')
tc=ti*(10^(-9))/3
fh=0.35*10^(-6)/tc
Tro=sqrt((ti*(10^(-9)))^2+(tc^2))*10^9
disp(Tro,fh,'(b)Minimum upper cut off frequency(in Mhz) and rise time(in ns)=')
```

Scilab code Exa 1.7 `Calculate lowest input frequency`

```
//Caption:Calculate lowest input frequency
//Exa:1.7
clc;
clear;
close;
fl=10//Lower cutoff frequency(in hertz)
t=0.02//Tilt on output waveform
f=%pi*fl/(t*1000)
disp(f,'Lowest input frequency(in Khz)=')
```

Scilab code Exa 1.8 `Determine upper cutoff frequency and lower cutoff frequency`

```
//Caption:Determine upper cutoff frequency and lower cutoff frequency
//Ex:1.8
clc;
clear;
```

```
close;
f=1//frequency of square wave(in khz)
tr=200//rise time of output(in ns)
t=0.03//fractional tilt
fh=0.35*10^3/tr
disp(fh,'(a)upper cutoff frequency(in mhz)=')
fl=f*t*1000/%pi
disp(fl,'(b)Lower cutoff frequency(in hz)=')
```

Scilab code Exa 1.9 Determine upper and lower Frequencies

```
//Caption:Determine upper and lower Frequencies
//Ex:1.9
clc;
clear;
close;
tr=30//Rise time(in micro sec)
PRF=2000//Pulse repetition Frequency(in pps)
t=0.082//Tilt(in %)
Pw=220//Pulse width(in micro sec)
fh=0.35*10^(6)/tr
fl=t*10^6/(2*%pi*Pw)
disp(fl,fh,'Upper and lower frequencies(in hz)=')
```

Chapter 2

RC circuits

Scilab code Exa 2.3 Calculate voltage after 8ms

```
//Caption:Calculate voltage after 8ms
//Ex:2.3
clc;
clear;
close;
c=1//Capacitance of capacitor(in micro farad)
vs=6//Source voltage(in volts)
r=10//Resistor(in kilo ohm)
vi=-3//Initial voltage(in volts)
t=8//Time (in milli sec)
e=vs-((vs-vi)*2.718^(-t/(r*c)))
disp(e,'Voltage after 8ms(in volts)=')
```

Scilab code Exa 2.4 Determine EC

```
//Caption:Determine (a)Ec at 1.5ms (b)Ec at 6ms
//Ex2.4
clc;
```

```
clear;
close;
r1=1//Resistor(in kilo ohm)
c1=1//Capacitance(in micro farad)
e1=10//Voltage(in volts)
r2=20//Resistor(in kilo ohm)
c2=0.1//Capacitance(in micro farad)
e2=12//Voltage(in volts)
t1=r1*c1*0.78
e=e1*1
ec1=e*t1
t2=r2*c2*0.025
E=e2*1
ec2=E*t2
disp(ec2,ec1,'(a)Ec at 1.5ms(in volts) and (b)Ec at 6ms(in volts)=')
```

Scilab code Exa 2.5 Calculate Rise time

```
//Caption:Calculate Rise time,time for capacitor to charge to required amount and time required for complete charging
//Ex2.5
clc;
clear;
close;
V=5//Voltage source(in volts)
r=39//Resistor(in kilo ohm)
c=500//Capacitance of capacitor(in pf)
tr=2.2*r*c*10^(-3)
t=r*c*10^(-3)
tc=5*r*c*10^(-3)
disp(tc,t,tr,'Rise time,time for  63.2% charging and time required for complete charging(in micro sec)=')
```

Scilab code Exa 2.6 Calculate minimum square wave frequency

```
//Caption:Calculate minimum square wave frequency
//Ex2.6
clc;
clear;
close;
C=1//Coupling capacitor(in micro farad)
R=1//Input resistance(in Mega ohm)
t=0.01//Tilt
PW=t*R*C
f=1/(2*PW)
disp(f,'Frequency required(in hertz)=')
```

Scilab code Exa 2.7 Determine fastest rise time

```
//Caption:Determine fastest rise time
//Ex2.7
clc;
clear;
close;
r=600//Output resistance(in ohms)
c=30//Input capacitance(in pf)
tr=2.2*r*c*10^(-3)
disp(tr,'Fastest rise time(in ns)=')
```

Scilab code Exa 2.8 Calculate voltage at 14 ms

```
//Caption:Calculate voltage at 14 ms
```

```
//Ex2.8
clc;
clear;
close;
Eo=0//Voltage at t=0sec(in volt)
E=20//Peak voltage(in volts)
r=3.3//Resistance(in kilo ohm)
c=1//Capacitance(in micro farad)
t1=4//Time(in ms)
t2=2//Time(in ms)
e1=E-((E-Eo)*(2.718)^(-t1/(r*c)))
e2=Eo-((Eo-e1)*(2.718)^(-t1/(r*c)))
e3=E-((E-e2)*(2.718)^(-t1/(r*c)))
e3=Eo-((Eo-e3)*(2.718)^(-t2/(r*c)))
disp(e3,'Voltage at 14ms(in volts)=')
```

Scilab code Exa 2.9 Determine max and min voltage at which capacitor voltage will

```
//Caption:Determine max and min voltage at which
   capacitor voltage will settle
//Ex2.9
clc;
clear;
close;
E=20//Peak voltage(in volts)
t=4//Time interval(in ms)
r=3.3//Resistance(in kilo ohms)
c=1//Capacitance(in micro farad)
Emax=E/(1+(2.718^(-t/(r*c))))
Emin=E-Emax
disp(Emin,Emax,'Maximum and minimum voltage(in volts
   )=')
```

Scilab code Exa 2.10 Calculate output voltage

```
//Caption:Calculate output voltage for (a)10V and 1 ms Pw (b)10V and 2ms PW (c)20V and 1ms PW
//Ex2.10
clc;
clear;
close;
e1=10//Voltage applied(in volts)
e0=0//Voltage at t=0sec(in volts)
t1=1//PW(in ms)
t2=2//PW(in ms)
e2=20//Input voltage(in volts)
r=10//Resistance(in kilo ohm)
c=20//Capacitance(in micro farad)
eo1=(e1-((e1-e0)*(2.718)^(-t1/(r*c))))*1000
eo2=(e1-((e1-e0)*(2.718)^(-t2/(r*c))))*1000
eo3=(e2-((e2-e0)*(2.718)^(-t1/(r*c))))*1000
disp(eo3,eo2,eo1,'Output voltage for(a)(in mv),(b)(in mv),(c)(in mv)=')
```

Scilab code Exa 2.11 Calculate output voltage

```
//Caption:Calculate output voltage for (a)10V and (b)20V
//Ex2.11
clc;
clear;
close;
E1=10//Input voltage(in volts)
E2=20//Input voltage(in volts)
c=1//Capacitance(in micro farad)
r=1//Resistance(in kilo ohm)
t=100//Pulse width(in ms)
i1=(c*E1*10^(-6))/(t*10^(-3))
```

```
eo1=i1*r*1000
disp(eo1,'Output voltage for (a)(in volts)=')
i2=(c*E2*10^(-6)/(t*10^(-3)))
eo2=i2*r*1000
disp(eo2,'Output voltage for (b)(in volts)=')
```

Scilab code Exa 2.12 Calculate amplitude of output waveform

```
//Caption:Calculate amplitude of output waveform for
    (a)Rise time (b)Fall time
//Ex2.12
clc;
clear;
close;
r=1//Resistance(in kilo ohm)
c=100//Capacitance(in pf)
tr=1//Rise time(in micro sec)
tf=3//Fall time(in micro sec)
e1=8//Change in voltage for rise time(in volts)
e2=-8//Change in voltage for fall time(in volts)
eo1=r*c*0.001*e1/tr
disp(eo1,'Amplitude of output waveform for (a)Rise
   time(in volts)=')
eo2=r*c*0.001*e2/tf
disp(eo2,'Amplitude of output waveform for (b)Fall
   time(in volts)=')
```

Chapter 3

Diode switching

Scilab code Exa 3.1 Forward Current

```
//Caption:Calculate (a)Resistance (b)Forward Current
    (c)Power dissipation (d)Peak Reverse Voltage
//Ex:3.1
clc;
clear;
close;
e=50//Input voltage(in volts)
i=20//Output Current(in mA)
v=0.5//Output voltage(in volts)
is=5//Reverse Leakage Current(in micro ampere)
vf=0.7//Forward voltage of diode(in volts)
R=v*1000/is
disp(R,'(a)Resistance(in Kilo ohm)=')
I=(e-vf)/R
P=(e^2)/R
if=i+I
disp(if,'(b)Forward Current(in mA)=')
p=vf*if
disp(p,'(c)Power Dissipation(in mW)=')
ep=-e
disp(ep,'(d)Peak Reverse Voltage(in volts)=')
```

Scilab code Exa 3.3 Calculate resistance and amplitude of output signal//Ex3.3

```
//Caption:Calculate resistance and amplitude of output signal
//Ex3.3
clc;
clear;
close;
E=2//Input voltage(in volts)
v=0.5//Input noise voltage(in volts)
Vf=0.7//Forward diode voltage(in volts)
if=1//Forward current of diode(in mA)
V=E-Vf
R=V/if
disp(V,R,'Resistance(in kilo ohm) and Output signal amplitude(in volts)=')
```

Scilab code Exa 3.4 Calculate Resistance and diode forward current

```
//Caption:Calculate Resistance and diode forward current
//Ex3.4
clc;
clear;
close;
E=10//Input voltage(in volts)
v=9//Output voltage(in volts)
i=1//Output current(in mA)
vf=0.7//Diode forward voltage(in volts)
R=E-v/i
if=E-vf/R
```

```
disp(if,R,'Resistance(in kilo ohm) and Diode forward
    current(in mA)=')
```

Scilab code Exa 3.5 `Calculate Resistance`

```
//Caption:Calculate Resistance
//Ex3.5
clc;
clear;
close;
V=2.7//Output voltage(in volts)
E=8//Input voltage(in volts)
i=1//Output current(in mA)
vf=0.7//Diode forward voltage(in volts)
if=1//Diode forward current(in mA)
vb=V-vf
R=(E-vb-vf)/(i+if)
disp(R,'Resistance(in kilo ohm)=')
```

Scilab code Exa 3.6 `Find Zener voltage and Resistance`

```
//Caption:Find Zener voltage and Resistance
//Ex3.6
clc;
clear;
close;
E=25//Input voltage(in volts)
V=11//Output voltage(in volts)
Vf=0.7//Forward diode voltage(in volts)
i=1//Output current(in mA)
v=9.1//Voltage for 1N757 diode
I=20//Current across 1N757 diode(in mA)
Vz=V-Vf
```

```
Vr=E-(Vf+v)
Iz=0.25*I
Ir=Iz+i
R=Vr/Ir
disp(R,Vz,'Zener voltage(in volts) and Resistance(in Kilo ohm)=')
```

Scilab code Exa 3.7 Calculate Capacitance and Resistance

```
//Caption:Calculate Capacitance and Resistance
//Ex3.7
clc;
clear;
close;
E=10//Input voltage(in volts)
f=1//Frequency(in Khz)
Rs=500//Source resistance(in ohms)
t=0.01//Tilt
T=1/(f)
pw=T*1000/2
C=pw/Rs
R=pw/(t*C*1000)
disp(R,C,'Capacitance(in micro farad) and Resistance(in Kilo ohm)=')
```

Scilab code Exa 3.8 Find Capacitance and Resistance required to design the circuit

```
//Caption:Find Capacitance and Resistance required to design the circuit
//Ex3.8
clc;
clear;
close;
```

```
E=20//Input waveform amplitude(in volts)
f=2//Frequency(in Khz)
t=0.02//Tilt
R=600//Resistance(in ohm)
T=1/f
pw=T*1000/2
C=pw/R
R=pw/(t*C)
disp(R,C,'Capacitance(in micro farad) and Resistance
    (in ohm)=')
```

Scilab code Exa 3.9 Calculate Capacitance

```
//Caption:Calculate Capacitance,Resistance and Zener
    Voltage
//Ex3.9
clc;
clear;
close;
E=15//Amplitude of input waveform(in volts)
Rs=1//Source Resistance(in Kilo ohm)
V=9//Output Voltage(in volts)
Vf=0.7//Diode forward voltage(in volts)
f=500//Frequency(in hertz)
t=0.01//Tilt
T=1000/f
pw=T/2
C=pw/Rs
R=pw/(t*C)
Vz=V-Vf
disp(Vz,R,C,'Capacitance(in micro farad),Resistance(
    in Kilo ohm) and Zener Voltage(in volts)=')
```

Scilab code Exa 3.10 Calculate Capacitance C1and C2

```
//Caption:Calculate Capacitance C1and C2,Diode
    reverse recovery time and input voltage
//Ex3.10
clc;
clear;
close;
V=12//Output voltage(in volts)
Vd=0.7//Diode forward voltage(in volts)
R=1.2//Load resistance(in Kilo ohm)
f=1//Frequency(in KHz)
r=10//Ripple in output voltage(in %)
Il=V/R
t=1000/(2*f)
C2=(Il*t)*10^(-3)/((r/(2*100))*V)
C1=(2*Il*t)*10^(-3)/((r/(2*100))*V)
trr=t/10
Vpp=V+((r/100)*V)+(2*Vd)
Vp=Vpp/2
disp(C1,C2,trr,Vp,'Input voltage(in volts),Diode
    reverse recovery time(in micro sec),C2 and C1(in
    micro farad)=')
```

Chapter 4

Transistor switching

Scilab code Exa 4.1 `hfe for changed resistor`

```
//Caption:Determine (a)hfe (b)hfe for changed
   resistor
//Ex4.1
clc;
clear;
close;
Ib=0.2//Base current(in mA)
Vcc=10//Collector voltage(in volts)
Rc1=1//Collector resistor(in kilo ohm)
Rc2=220//Changed collector resistor(in ohm)
Ic1=Vcc/Rc1
h1=Ic1/Ib
disp(h1,'(a)hfe=')
Ic2=Vcc*1000/Rc2
h2=Ic2/Ib
disp(h2,'(b)hfe for changed resistor=')
```

Scilab code Exa 4.2 `Calculate the transistor power dissipation at`

```
//Caption:Calculate the transistor power dissipation
     at (a)Cutoff (b)Saturation (c)When Vce is 2V
//Ex4.2
clc;
clear;
close;
Vcc=10//Collector voltage(in volts)
Ic=50//Collector current(in nA)
Rc=1//Collector resistor(in kilo ohm)
Vs=0.2//Voltage of collector emitter junction at
    saturation(in volts)
Vce=2//Collector emitter voltage(in volts)
P1=Ic*Vcc/1000
disp(P1,'(a)Power dissipation at cutoff(in micro
    watt)=')
P2=(Vcc/Rc)*Vs
disp(P2,'(b)Power dissipation at saturation(in mW)='
    )
I=(Vcc-Vce)/Rc
P3=I*Vce
disp(P3,'(c)Power dissipation at given Vce(in mW)=')
```

Scilab code Exa 4.3 Before input pulse is applied

```
//Caption:Calculate Vce (a)Before input pulse is
    applied (b)at end of delay time (c)at end of turn
     on time (d)Total time
//Ex4.3
clc;
clear;
close;
Vcc=12//Collector voltage(in volts)
Rc=3.3//Collector resistor(in Kilo ohm)
pw=5//Pulse width of input voltage(in micro sec)
Ix=50//Collector cutoff current(in nA)
```

```
t=250//Switch off time(nA)
Vce=Vcc-(Ix*Rc*10^(-6))
disp(Vce,'(a)Collector emitter voltage before input pulse is applied(in volts)=')
Vce2=Vcc-(0.1*Vcc)
disp(Vce2,'(b)Collector emittter voltage at end of delay time(in volts)=')
Vce3=Vcc-(0.9*Vcc)
disp(Vce3,'(c)Collector emitter voltage at end of turn on time(in volts)=')
T=(t*10^(-3))+pw
disp(T,'(d)Total time from commencement of input to transistor switch off(in micro sec)=')
```

Scilab code Exa 4.4 Capacitance that can give max turn on time

```
//Caption:Determine (a)Capacitance that can give max turn on time (b)Max frequency
//Ex4.4
clc;
clear;
close;
Rs=600//Source resistor(in ohm)
Rb=5.6//Base resistor(in kilo ohm)
t=70//Turn on time(in ns)
C=t*1000/(0.1*Rs)
disp(C,'(a)Required capacitance(in pF)=')
tre=2.3*Rb*C*10^(-3)
f=1000/(2*tre)
disp(f,'(b)Max Frequency(in Khz)=')
```

Scilab code Exa 4.5 Calculate Rc and Rb

```
//Caption:Calculate Rc and Rb
//Ex4.5
clc;
clear;
close;
Vcc=12//Collector voltage(in volts)
V=3//Input voltage(in volts)
Ic=1//collector current(in mA)
Vce=0.2//Saturated collector emitter voltage(in
    volts)
hfe=70
Vbe=0.7//Base emitter voltage(in volts)
Rc=(Vcc-Vce)/Ic
Ib=Ic*1000/hfe
Rb=(V-Vbe)*1000/Ib
disp(Rb,Rc,'Rc and Rb(in kilo ohm)=')
```

Scilab code Exa 4.6 `Determine maximum value of capacitor`

```
//Caption:Determine maximum value of capacitor
//Ex4.6
clc;
clear;
close;
f=45//Frequency(in khz)
Rb=150//Base Resistor(in ohms)
t=1000/(2*f)
C=t*1000/(2.3*Rb)
disp(C,'Maxixmumvalue of capacitor(in pF)=')
```

Scilab code Exa 4.7 `Design a transistor by determining Rc`

```
//Caption:Design a transistor by determining Rc,Rb
    and amplitude of output waveform
//Ex4.7
clc;
clear;
close;
E=10//Input voltage(in volts)
Vcc=15//Collector voltage(in volts)
R=100//Load resistance(in kilo ohm)
Vce=0.2//Saturted collector emitter voltage(in volts
    )
Vd=0.7//Diode forward voltage(in volts)
hfe=35
Vbe=0.7//Base emitter voltage(in volts)
Rc=R/10
Ic=(Vcc-Vce-Vd)/Rc
Ib=Ic/hfe
Rb=(E-Vbe-Vd)/Ib
Vmin=Vd+Vce
Vmax=(Vcc*R)/(R+Rc)
Vo=Vmax-Vmin
disp(Vo,Rb,Rc,'Rc,Rb(in kilo ohm),and amplitude of
    output waveform(in volts)=')
```

Scilab code Exa 4.8 Calculate Rc Rb and Cc

```
//Caption:Calculate Rc,Rb,and Cc
//Ex4.8
clc;
clear;
close;
Vcc=10//Collector voltage(in volts)
Vce=0.2//Saturated collector emitter voltage(in
    volts)
Ic=10//Collector current(in mA)
```

```
Vbe=0.7//Base emitter voltage(in volts)
hfe=100
Pw=1//Pulse width(in ms)
Vi=4//Input voltage(in volts)
Rc=(Vcc-Vce)*1000/Ic
Ib=Ic*1000/hfe
Rb=(Vcc-Vbe)*1000/Ib
Vb=Vi-Vbe-0.5
I=(Vcc+Vi)/Rb
Cc=I*Pw/Vb
disp(Cc,Rb,Rc,'Rc(in ohm),Rb(in kilo ohm),Cc(in micro farad)=')
```

Scilab code Exa 4.9 Determine required capacitance

```
//Caption:Determine required capacitance
//Ex4.9
clc;
clear;
close;
E=4//Input voltage(in volts)
Pw=1//Pulse width(in ms)
Rs=1//Source resistance(in kilo ohm)
Vce=0.2//Saturated Collector emitter voltage(in volts)
Rc=1//Collector resistance(in kilo ohm)
Vcc=10//Collector voltage(in volts)
hfe=100
Vbe=0.7//Base emitter voltage(in volts)
Rb=10//Base resistance(in kilo ohm)
Ic=(Vcc-Vce)/Rc
Ib=Ic*1000/hfe
Irb=Vbe*1000/Rb
ic=Ib+Irb
I=(E-Vbe)/Rs
```

```
C=Pw/(Rs*(log(I*1000/ic)))
disp(C,'Required capacitance(in micro farad)=')
```

Scilab code Exa 4.10 Determine output voltage

```
//Caption:Determine output voltage when (a)Device is cutoff (b)Device is switched on
//Ex4.10
clc;
clear;
close;
Idf=0.25//Drain current at cutoff(in ns)
rd=40//Drain resistance at switched on(in ohm)
Vdd=15//Drain voltage(in volts)
Rd=6.8//Drain resistance(in kilo ohm)
Vo=Vdd-(Idf*Rd*10^(-6))
disp(Vo,'Output voltage when device is cutoff(in volts)=')
Id=Vdd/Rd
Vo2=Id*rd
disp(Vo2,'Output voltage when device is switched on(in milli volts)=')
```

Chapter 5

IC operational amplifiers in switching circuits

Scilab code Exa 5.1 design a non inverting amplifier

```
//Caption:Design a non inverting amplifier by
   determining Required resistances and output
   voltage
//Ex5.1
clc;
clear;
close;
Av=28//Voltage gain
E=50//Input voltage(in mV)
Ib=500//Base current(in nA)
i=100*Ib*0.001
R3=E/i
Vo=Av*E*0.001
r=Vo*1000/i
R2=r-R3
R1=(R2*R3)/(R2+R3)
disp(R1,R2,R3,Vo,'Output voltage(in volts),Required
   resistances R3,R2 and R1(in kilo ohm)=')
```

Scilab code Exa 5.3 Design an inverter by determining input resistance

```
//Caption:Design an inverter by determining input
   resistance,current and capacitance
//Ex5.3
clc;
clear;
close;
Vo=11//Output voltage(in volts)
Vcc=12//Collector voltage(in volts)
Vi=6//Input voltage(in volts)
f=1//Frequency(in Khz)
Vb=0.5//Base voltage(in volts)
Vee=-12//Emitter voltage(in volts)
Ib=500//Max base current(in nA)
Vc=2//Collector voltage(in volts)
Vr2=Vb-Vee
I2=100*Ib*0.001
R2=Vr2/I2
i=Vr2/R2
R1=(Vcc-Vb)/i
Ri=(R1*R2)*1000/(R1+R2)
Ii=Vi*1000/Ri
pw=1000/(2*f)
C=(Ii*pw)*10^(-6)/Vc
disp(C,Ii,Ri,'Input resistance(in kilo ohm),Input
   current(in micro ampere) and Capacitance(in micro
    farad)=')
```

Scilab code Exa 5.4 Design a differentiating circuit by determining required resis

```
//Caption:Design a differentiating circuit by determining required resistances and capacitance
//Ex5.4
clc;
clear;
close;
Vo=5//Output voltage(in volts)
Vi=1//Change in input voltage(in volts)
t=100//Time period(in micro sec)
I=1//Circuit current(in mA)
R2=Vo/I
R1=R2*1000/20
R3=R2
C=Vo*t/(R2*Vi*1000)
disp(R3,R2,R1,C,'Required components for circuit are Capacitance(in micro farad),Resistances R1(in ohm),R2(in kilo ohm),R3(in kilo ohm)=')
```

Scilab code Exa 5.5 `Calculate lowest operating frequency for circuit`

```
//Caption:Calculate lowest operating frequency for circuit
//Ex5.5
clc;
clear;
close;
V=4//Peak to peak amplitude of output waveform(in volts)
Vi=10//Input voltage(in volts)
Vs=15//Supply voltage(in volts)
Ib=500//Maximum Base current(in nA)
f=250//Frequency of input waveform(in hz)
I=1//Circuit current(in mA)
R1=Vi/I
R3=20*R1
```

```
R2=(R3*R1)/(R1+R3)
t=1000/(2*f)
C=(I*t)/V
F=20*1000/(2*%pi*C*R3)
disp(F,'Required frequency(in hz)=')
```

Chapter 6

Schmit Trigger Circuits and voltage comparators

Scilab code Exa 6.1 Determine schmitt trigger circuit components for designing it

```
//Caption:Determine schmitt trigger circuit
   components for designing it
//Ex6.1
clc;
clear;
close;
u=5//Upper trigger point voltage(in volts)
Vbe=0.7//Base emitter voltage(in volts)
I=2//Collector current(in mA)
hfe=100
Vcc=12//Collector voltage(in volt)
Vce=0.2//Saturated collector emitter voltage(in
   volts)
Ve=u-Vbe
Re=Ve/I
Rc=(Vcc-Ve-Vce)/I
i=I/10
R2=u/i
Ib2=I/hfe
```

```
I2=u/i
It=Ib2+i
r=(Vcc-u)/It
R1=r-Rc
disp(R1,R2,Rc,Re,'Circuit components Re,Rc,R2,R1(in kilo ohm)=')
```

Scilab code Exa 6.2 Find circuit components for designing a schmitt trigger circui

```
//Caption:Find circuit components for designing a schmitt trigger circuit
//Ex6.2
clc;
clear;
close;
u=5//Upper trigger point voltage(in volts)
Vbe=0.7//Base emitter voltage(in volts)
I=2//Collector current(in mA)
hfe=100
Vcc=12//Collector voltage(in volt)
Vce=0.2//Saturated collector emitter voltage(in volts)
l=3//Lower trigger point voltage(in volts)
Ve=u-Vbe
Re=Ve/I
Rc=(Vcc-Ve-Vce)/I
i=I/10
R2=u/i
Ib2=I/hfe
I2=u/i
It=Ib2+i
r=(Vcc-u)/It
I1=l/R2
Ie=(l-Vbe)/Re
Rc1=Vcc-(I1*(r+R2))/Ie
```

```
R1=r-Rc1
disp(R1,R2,Rc1,Re,'Circuit components are Re,Rc1,R2,
   R1(in kilo ohm)=')
```

Scilab code Exa 6.3 Determine Largest speed up capacitance

```
//Caption:Determine Largest speed up capacitance
//Ex6.3
clc;
clear;
close;
f=1//Frequency(in Mhz)
R1=22//Resistance(in kilo ohm)
R2=22//Resistance(in kilo ohm)
Rc1=4.7//Resistance(in kilo ohm)
R=R1*(Rc1+R2)/(R1+Rc1+R2)
t=1/f
C=t*1000/(2.3*R)
disp(C,'Required Capacitance(in pF)=')
```

Scilab code Exa 6.4 Actual UTP and LTP

```
//Caption:Calculate R1,R2 and Actual UTP and LTP
//Ex6.4
clc;
clear;
close;
u=3//Upper trigger voltage(in volts)
Ib=500//Max base current(in nA)
Vcc=15//Collector voltage(in volts)
i=Ib*0.1
R2=u*1000/i
I=u/R2
```

```
Vo=Vcc-1
Vr1=Vo-u
R1=Vr1/I
utp=Vo*R2/(R1+R2)
ltp=-utp
disp(ltp,utp,R2,R1,'Circuit components R1,R2(in kilo
    ohm) and actual UTP and LTP(in volts)=')
```

Scilab code Exa 6.5 Design Schmitt circuit components

```
//Caption:Design Schmitt circuit components R1,R2,R3
   ,R4 and R5
//Ex6.5
clc;
clear;
close;
u=3//Upper trigger voltage(in volts)
Ib=500//Max base current(in nA)
Vf=0.7//Forward diode voltage(in volts)
Vk1=-2//Voltage(in volts)
Vcc=15//Collector voltage(in volts)
Vk2=-Vk1
i=Ib*0.1
R2=u*1000/i
I=u/R2
Vo=Vcc-1
Vr1=Vo-u
R1=Vr1/I
I4=100*i
Va1=Vk1+Vf
Vee=-Vcc
V4=Va1-Vee
R4=V4*1000/I4
Va2=Vk2+Vf
V5=Va2-Va1
```

```
R5=V5*1000/I4
R3=(Vcc-Va2)*1000/I4
disp(R5,R4,R3,R2,R1,'R1,R2,R3,R4,R5(in kilo ohm)=')
```

Scilab code Exa 6.6 Design a non inverting schmitt trigger circuit

```
//Caption:Design a non inverting schmitt trigger circuit
//Ex6.6
clc;
clear;
close;
Vcc=15//Collector voltage(in volts)
u=2//Upper trigger point(in volts)
Ib=500//Base current(in nA)
I2=Ib*0.1
Vo=Vcc-1
R2=Vo*1000/I2
i=Vo*1000/R2
R1=u*1000/i
disp(R2,R1,'Circuit components R1 and R2(in kilo ohm)=')
```

Chapter 7

Monostable and astable multivibrators

Scilab code Exa 7.1 Design a collector coupled monostable multivibrator

```
//Caption:Design a collector coupled monostable
    multivibrator by determining rc,rb,r2,r1 and vb1
//Ex7.1
clc;
clear;
close;
vs=9//Supply voltage(in volts)
Ic=2//Collector current(in mA)
hfe=50
vd=0.7//Diode forward voltage(in volts)
vce=0.2//Saturated collector emitter voltage(in
    volts)
Vbb=-9//Base voltage(in volts)
Vbe=0.7//Base emitter voltage(in volts)
Rc=(vs-vd-vce)/Ic
Ib2=Ic*1000/hfe
Rb=(vs-Vbe-vd)*1000/Ib2
I2=Ic*1000/10
Vr2=Vbe-Vbb
```

```
R2=Vr2*1000/I2
i=Ib2+I2
r=(vs-Vbe)*1000/i
R1=r-Rc
Vc2=vd+vce
Vr1=R1*(vs-Vbb)/(R1+R2)
Vb1=Vc2-Vr1
disp(Vb1,R1,R2,Rb,Rc,'Required components for circuit design are Rc,Rb,R2,R1(in kilo ohm) and Vb1(in volts)=')
```

Scilab code Exa 7.2 Find capacitance

```
//Caption:Find capacitance
//Ex7.2
clc;
clear;
close;
t=250//Pulse width(in micro sec)
E=9//Input voltage(in volts)
Vbe=0.7//Base emitter voltage(in volts)
Vd=0.7//Diode forward voltage(in volts)
Rb=180//Base resistor(in kilo ohm)
Eo=-(E-Vbe-Vd)
C=t*1000/(Rb*log((E-Eo)/E))
disp(C,'Required capacitance(in pF)=')
```

Scilab code Exa 7.3 Design a monostable multivibrator using op amp 741

```
//Caption:Design a monostable multivibrator using op amp 741
//Ex7.3
clc;
```

```
clear;
close;
Vcc=15//Collector voltage(in volts)
Vt=1.5//Trigger voltage(in volts)
t=200//Output pulse width(in micro sec)
Ib=500//Base current(in nA)
Vr2=1//R2 Resistor voltage(in volts)
I2=0.1*Ib
R2=Vr2*1000/I2
i2=Vr2*1000/R2
Vr1=Vcc-Vr2
R1=Vr1*1000/i2
R3=(R1*R2)/(R1+R2)
E=Vr2-(Vcc-1)
ec=Vcc-1
Ec=Vr2+(Vcc-1)
Rc=R1*R2/(R1+R2)
C=t*1000/(Rc*log((Vcc-E)/(Vcc-ec)))
disp(C,R3,R2,R1,'Circuit components are resistances
    R1,R2,R3(in kilo ohm) and Capacitance(in pF)=')
```

Scilab code Exa 7.4 Design a astable multivibrator

```
//Caption:Design a astable multivibrator
//Ex7.4
clc;
clear;
close;
f=1//Frequency of output waveform(in Khz)
Vs=5//Supply voltage(in volts)
Il=20//Output load current(in micro Ampere)
hfe=70
Vbe=0.7//Base emitter voltage(in volts)
Ic=Il*100/1000
Rc=Vs/Ic
```

```
Ib=Ic/hfe
Rb=(Vs-Vbe)/Ib
pw=1/(2*f)
C=pw*10^(6)/(0.69*Rb)
disp(C,Rb,Rc,'Components required to design a astable multivibrator are resistances Rb,Rc(in kilo ohm) and Capacitance(in pf)=')
```

Scilab code Exa 7.5 Design a astable multivibrator using 741 op amp//Ex7.5

```
//Caption:Design a astable multivibrator using 741 op amp
//Ex7.5
clc;
clear;
close;
f=300//Output frequency(in hertz)
Vo=11//Output Amplitude(in volts)
utp=0.5//Upper trigger voltage(in volts)
Vr3=0.5//Votage across R3 resistor(in volts)
Ib=500//Base current(in nA)
Vcc=Vo+1
I2=100*Ib/1000
R3=Vr3*1000/I2
Vr2=Vo-Vr3
R2=Vr2*1000/I2
Ir1=100*Ib/1000
Vr1=Vo-Vr3
R1=Vr1*1000/Ir1
t=1000/f
tc1=0.5*t
ltp=-utp
v=utp-ltp
C=Ir1*tc1*10^(-3)/v
disp(C,R3,R2,R1,'Circuit components for designing
```

```
    astable multivibrator are R1,R2,R3(in kilo ohm)
    and Capacitance(in micro farad)=')
```

Scilab code Exa 7.6 Design a astable multivibrator using 311 comparator

```
//Caption:Design a astable multivibrator using 311
    comparator
//Ex7.6
clc;
clear;
close;
V=12//Supply voltage(in volts)
f=3//Frequency(in Khz)
Ib=250//Base current(in nA)
R2=1//Selected resistor(in kilo ohm)
I4=100*Ib/1000
Vr4=V/3
R4=Vr4*1000/I4
R3=R4
R5=R4
Ir2=V/R2
Ir1=100*Ib/1000
Vr1=Vr4
R1=Vr1*1000/Ir1
t=1000/(2*f)
C=t*1000/(R1*(log (2)))
disp(C,R5,R4,R3,R2,R1,'Circuit components required
    to design the circuit are R1,R2,R3,R4,R5(in kilo
    ohm) and Capacitance(in pF)=')
```

Chapter 8

IC timer circuits

Scilab code Exa 8.1 Design a 555 monostable circuit

```
//Caption:Design a 555 monostable circuit
//Ex8.1
clc;
clear;
close;
t=1//Pulse width(in ms)
Vcc=15//Supply voltage(in volts)
Ith=0.25//Threshold current(in micro Ampere)
Ic=100*Ith
R=Vcc*1000/(3*Ic)
C=t*10^6/(1.1*R)
disp(C,R,'Components required for designing 555
    monostable circuit are R(in kilo ohm) and C(in pF
    )=')
```

Scilab code Exa 8.2 Design a 555 astable multivibrator

```
//Caption:Design a 555 astable multivibrator
```

```
//Ex8.2
clc;
clear;
close;
p=2//Pulse repetition frequency(in Khz)
d=0.66//Duty cycle
Ic=1//Minimum collector voltage selected(in mA)
Vcc=18//Supply voltage(in volts)
t=1000/p
t1=d*t
t2=t-t1
R=Vcc/(3*Ic)
C=t1*0.001/(0.693*R)
Rb=t2*0.001/(0.693*C)
Ra=R-Rb
disp(C,Rb,Ra,'Components required to design the circuit are resistors Ra,Rb(in kilo ohm) and Capacitance(in micro farad)=')
```

Scilab code Exa 8.3 Determine actual PRF and duty cycle

```
//Caption:Determine actual PRF and duty cycle
//Ex8.3
clc;
clear;
close;
C=0.082//Capacitance(in micro farad)
Ra=3.3//Resistance(in kilo ohm)
Rb=2.7//Resistance(in kilo ohm)
t1=0.693*C*(Ra+Rb)*1000
t2=0.693*C*Rb*1000
T=t1+t2
P=1000/T
d=t1*100/T
disp(P,d,'Duty cycle(in %) and PRF(in Khz)=')
```

Scilab code Exa 8.4 Design a square wave generator using 7555 CMOS

```
//Caption:Design a square wave generator using 7555
   CMOS
//Ex8.4
clc;
clear;
close;
V=5//Supply voltage(in volts)
f1=1//Frequency(in khz)
f2=3//Frequency(in khz)
C=0.01//Capacitance(in micro farad)
Ra=47//Choosed resistor(in kilo ohm)
t1=1/(2*f1)
t2=1/(2*f2)
R=t1/(0.693*C)
Rb=R-Ra
disp(C,Rb,Ra,'Components required to design the
   circuit are Ra,Rb(in kilo ohm) and Capacitance(in
    micro farad)=')
```

Chapter 9

Ramp Pulse and function generator

Scilab code Exa 9.1 esign RC ramp generator//Ex9.1

```
//Caption:Design RC ramp generator
//Ex9.1
clc;
clear;
close;
V=5//Output voltage(in volts)
Vs=15//Supply voltage(in volts)
R=100//Load resistance(in kilo ohm)
v=3//Amplitude of triggering pulse(in volts)
vb=0.5//Bse voltage(in volts)
p=1//Pulse width(in ms)
t=0.1//Time interval(in ms)
vbe=0.7//Base emitter voltage(in volts)
E=0.2//Initial voltage(in volts)
e=5//Final voltage(in volts)
hfe=50
Il=V/R
I1=100*Il/1000
R1=(Vs-V)/(I1*1000)
```

```
C1=p/(R1*log((Vs-E)/(Vs-e)))
Ic=10*I1
Ib=Ic/hfe
Rb=(Vs-vbe)/(Ib*1000)
Vbb=v-vbe-vb
I=(Vs+v)/Rb
C2=I*p/Vbb
disp(C2,C1,R1,Rb,'Components required to design
    circuit are resistances Rb,R1(in kilo ohm) and
    Capacitors C1,C2(in micro farad)=')
```

Scilab code Exa 9.2 Design a linear ramp generator

```
//Caption:Design a linear ramp generator
//Ex9.2
clc;
clear;
close;
V=5//Output voltage(in volts)
Vcc=15//Supply voltage(in volts)
Vce2=3//Voltage(in volts)
C1=1//Capacitance(in micro fard)
t=1//pulse width(in ms)
Vbe=0.7//Base emitter voltage(in volts)
V3=Vcc-Vce2-5
Ic=C1*V/t
R3=V3/Ic
Vb=V3+Vbe
I1=Ic/10
R1=Vb/I1
i1=Vb/R1
V2=Vcc-Vb
R2=V2/I1
disp(C1,R3,R2,R1,'Components required to design the
    circuit are resistors R1,R2,R3(in kilo ohm) and
```

```
    capacitance C1(in micro farad)=')
```

Scilab code Exa 9.4 `Determine Rsmax,Rsmin,and minimum drain source voltage`

```
//Caption:Determine Rsmax,Rsmin,and minimum drain
   source voltage
//Ex9.4
clc;
clear;
close;
I=2//Drain Current(in mA)
Vgsm=3//Maximum gate source voltage(in volts)
Vgsn=0.5//Minimum gate source voltage(in volts)
V=6//Peak voltage(in volts)
Rs1=Vgsm/I
Rs2=Vgsn*1000/I
Vds=V-Vgsm+1
disp(Vds,Rs2,Rs1,'Required resistances Rsmax(in kilo
    ohm),Rsmin(in ohm) and drain source voltage(in
   volts)=')
```

Scilab code Exa 9.5 `find peak to peak output amplitude`

```
//Caption:Design a UJT relaxation oscillator and
   find peak to peak output amplitude
//Ex9.5
clc;
clear;
close;
Vbb=20//Supply voltage(in volts)
f=5//Frequency(in khz)
Veb=3//Fringe Voltage(in volts)
Ip=2//Fringe current(in micro ampere)
```

```
Iv=1//Emitter current(in mA)
n=0.75
Vp=0.7+(n*Vbb)
R1x=(Vbb-Vp)/Ip
R1n=(Vbb-Veb)/Iv
t=1000/f
C1=t*1000/(R1n*(log((Vbb-Veb)/(Vbb-Vp))))
E=Vp-Veb
disp(C1,R1n,E,'Peak to peak voltage(in volts) and
    Components for circuit are resistor(in kilo ohm)
    and capacitance(in pf)=')
```

Scilab code Exa 9.6 Design a transistor bootstrap ramp generator

```
//Caption:Design a transistor bootstrap ramp
    generator
//Ex9.6
clc;
clear;
close;
V=8//Amplitude of output voltage(in volts)
Vd=0.7//Forward diode voltage(in volts)
Vce=0.2//Saturated collector emitter voltage(in
    volts)
t=1//Interval between pulses(in ms)
Vt=3//Triggering voltage(in volts)
E=15//Supply voltage(in volts)
vbe=0.7//Base emitter voltage(in volts)
vb=0.5//Bse voltage(in volts)
hfe=100
R=1//Load resistor(in kilo ohm)
Ie1=E/R
Ie2=(V-(-E))/R
Ib1=Ie1/hfe
Ib2=Ie2/hfe
```

```
Ibc=Ib2-Ib1
I1=100*Ibc/1000
C1=I1*t*1000/V
Vr1=E-Vd-Vce
R1=Vr1/I1
Vc3=E/100
C3=I1*t*1000/Vc3
Il=V/R
I1=100*Il/1000
Ic=10*I1
Ib=Ic/hfe
Rb=(E-vbe)/(Ib*1000)
Vbb=V-vbe-vb
I=(E+Vt)/Rb
C2=I*t/Vbb
disp(C3,C2,C1,Rb,'Circuit components are resistor Rb
    (in kilo ohm) and capacitances C1,C2,C3(in micro
    farad)=')
```

Scilab code Exa 9.9 Calculate drain current

```
//Caption:Calculate drain current
//Ex9.9
clc;
clear;
close;
V=5//Output peak voltage(in volts)
p=1//Pulse width(in ms)
s=50//Space width(in micro sec)
C=0.03//Capacitance(in micro farad)
Vp=6//Gate source voltage(in volts)
I1=C*V*1000/p
Vi=Vp+1
R1=Vi/I1
Id=I1*p/s
```

```
disp(Id,'Drain current(in mA)=')
```

Scilab code Exa 9.12 Design a pulse generator using 8038 IC

```
//Caption:Design a pulse generator using 8038 IC
//Ex9.12
clc;
clear;
close;
p=200//Pulse width(in micro sec)
f=1//Pulse repetition frequency(in khz)
V=10//Output voltage(in volts)
I=1//Maximum current(in mA)
T=1000/f
t2=T-p
Ib=I*p/t2
Ra=V/(5*I)
C=0.6*p/(Ra*1000)
Rb=2*V/(5*(I+Ib))
Rl=V/I
disp(Ra,Rb,Rl,C,'Circuit components are Capacitance(
    in micro farad) and Resistances Rl,Rb,Ra(in kilo
    ohm)=')
```

Scilab code Exa 9.13 Calculate output maximum and minimum frequencies

```
//Caption:Calculate output maximum and minimum
    frequencies
//Ex9.13
clc;
clear;
close;
V=15//Supply voltage(in volts)
```

```
Imin=10//Minimum current(in micro ampere)
Imax=1//Maximum current(in mA)
C=3600//Capacitor(in pF)
Rmax=V/(10*Imin)
Rmin=V/(10*Imax)
fmin=0.15*10^6/(C*Rmax)
fmax=0.15*10^6/(C*Rmin)
disp(fmin,fmax,'Maximum frequency(in khz) and
    minimum frequency(in hz)=')
```

Chapter 10

Basic Logic gates and logic functions

Scilab code Exa 10.1 `Determine low and high voltage outputs`

```
//Caption:Determine low and high voltage outputs and
    resistance for desinging the gate circuit
//Ex10.1
clc;
clear;
close;
Vcc=5//Supply voltage(in volts)
Vf=0.7//Diode forward voltage(in volts)
I=0.5//Collector current(in mA)
Vce=0.2//Collector emitter voltage(in volts)
R=(Vcc-Vf-Vce)/I
Vl=Vce+Vf
Vh=Vcc
disp(R,Vh,Vl,'Low and high voltage outputs(in volts)
    and Required resistance(in kilo ohm)=')
```

Scilab code Exa 10.2 Find minimum value of the resistance to design OR Gate

```
//Caption:Find minimum value of the resistance to
   design OR Gate
//Ex10.2
clc;
clear;
close;
Rc=3.3//Collector resistance(in kilo ohm)
V=3.5//Gate output voltage(in volts)
Vcc=5//Supply voltage(in volts)
Vf=0.7//Forward diode voltage(in volts)
I=(Vcc-Vf-V)/Rc
R=V/I
disp(R,'Minimum value of resistance to design the
   circuit is(in kilo ohm)=')
```

Chapter 11

Logic circuits

Scilab code Exa 11.3 `Determine output for given logic circuit`

```
//Caption:Determine output for given logic circuit
//Ex11.3
clc;
clear;
close;
A=1
B=0
C=1
D=1
c=A-1
n=c//Output of NOT gate
a=B*C*D//Output of AND gate
o=c+(B*C*D)//Output of OR gate
disp(o,'Output for given logic circuit is=')
```

Chapter 12

IC logic gates

Scilab code Exa 12.1 Determine fan out for DTL NAND gate

```
//Caption: Determine fan out for DTL NAND gate
//Ex12.1
clc;
clear;
close;
hfe=20
Vbe=0.7//Base emitter voltage(in volts)
R3=6//Resistance(in kilo ohm)
R2=5//Resistance(in kilo ohm)
Vcc=5//Supply voltage(in volts)
R1=2//Resistance(in kilo ohm)
Vce=0.2//Collector emitter voltage(in volts)
Vf4=0.7//Diode forward voltage
Vf5=Vf4
Vf6=Vf4
I2=Vbe/R2
Va=Vf4+Vf5+Vbe
I1=(Vcc-Va)/R1
Ib=I1-I2
Ic1=hfe*Ib
I3=(Vcc-Vce)/R3
```

```
Iol=Ic1-I3
R4=R1
Iil=(Vcc-Vf6)/R4
fo=Iol/Iil
disp(fo,'Fan out=')
```

Scilab code Exa 12.2 Determine Resistance to drive inputs of 5 TTL gates

```
//Caption:Determine Resistance to drive inputs of 5
   TTL gates
//Ex12.2
clc;
clear;
close;
Ii=1.6//Maximum input current(in mA)
Io=16//Maximum output current(in mA)
Vcc=5//Supply voltage(in volts)
Vo=0.4//Maximum output voltage(in volts)
Il=5*Ii
Irc=Io-Il
Vrc=(Vcc-Vo)
Rc=Vrc*1000/Irc
disp(Rc,'Required resistance(in ohm)=')
```

Scilab code Exa 12.4 Design a interface circuit for CMOS

```
//Caption:Design a interface circuit for CMOS
//Ex12.4
clc;
clear;
close;
Vdd=15//Drain voltage(in volts)
Rd=1//Drain resistance(in kilo ohm)
```

```
Vcc=5//Supply voltage(in volts)
Ih=40//Current(in micro ampere)
hfe=20
Vce=0.2//Saturated collector emitter voltage(in
    volts)
vih=2//High input voltage(in volts)
il=1.6//Low input current
Vbe=0.7//Base emitter voltage(in volts)
Rc=(Vcc-vih)*1000/(2*Ih)
Ic=((Vcc-Vce)/Rc)+(2*il)
Ib=Ic/hfe
R=(Vdd-Vbe)/Ib
Rb=R-Rd
disp(Rc,Rb,'Components required to design circuit
    are resistors Rb and Rc(in kilo ohm)=')
```

Chapter 13

Bistable Multivibrators

Scilab code Exa 13.1 Design a collector coupled bistable multivibrator

```
//Caption:Design a collector coupled bistable multivibrator
//Ex13.1
clc;
clear;
close;
V=5//Supply voltage(in volts)
Ic=2//Saturated collector current(in mA)
Vce=0.2//Collector emitter voltage(in volts)
hfe=70
Vbe=0.7//Base emitter voltage(in volts)
Vbb=-5//Base voltage(in volts)
Rc=(V-Vce)/Ic
Ib=Ic/hfe
Vb1=Vbe-Vbb
I2=Ic/10
R2=Vb1/I2
I2=Vb1/R2
R=(V-Vbe)/(I2+Ib)
R1=R-Rc
disp(Rc,R1,R2,'Components required to design the
```

```
   circuit are resistors(in kilo ohm)=')
```

Scilab code Exa 13.4 Determine the capacitance for flip flop

```
//Caption:Determine the capacitance for flip flop
   design and triggering frequency
//Ex13.4
clc;
clear;
close;
R1=15//Resistor(in kilo ohm)
R2=27//Resistor(in kilo ohm)
t=250//time(in ns)
R=R1*R2/(R1+R2)
C=t/(0.1*R)
f=10^6/(2.3*C*R)
disp(f,C,'Capacitance(in pF) and Frequency(in Khz)='
   )
```

Chapter 14

Digital counting and measurement

Scilab code Exa 14.1 `Determine Resistors Rc and Rb`

```
//Caption:Determine Resistors Rc and Rb
//Ex14.1
clc;
clear;
close;
Vcc=5//Collector voltage(in volts)
Vi=5//Input voltage(in volts)
Vf=1.2//Diode forward voltage(in volts)
hfe=100
I=20//Diode minimum forward current(in mA)
Vce=0.2//Collector emitter saturated voltage(in
   volts)
Vbe=0.7//Base emitter voltage(in volts)
Rc=(Vcc-Vf-Vce)*1000/I
Ib=I*1000/hfe
Rb=(Vi-Vbe)*1000/Ib
disp(Rb,Rc,'Resistors are Rc and Rb(in kilo ohm)=')
```

Scilab code Exa 14.5 Determine meter indication when time base uses

```
//Caption:Determine meter indication when time base
   uses (a)6 decade counter (b)4 decade counter
//Ex14.5
clc;
clear;
close;
f=3500//Applied frequency(in hz)
F=10^6//Clock generator frequency(in hz)
f1=F/(10^6)
t1=1/f1
c1=f*t1
disp(c1,'Cycles of input counted during t1=')
f2=F/(10^4)
t2=1/f2
c2=f*t2
disp(c2,'Cycles of input counted during t2=')
```

Scilab code Exa 14.6 Determine required current

```
//Caption:Determine required current
//Ex14.6
clc;
clear;
close;
c=1280//Input wave clock cycles
f=200//Output frequency(in khz)
p=1000//Pulses during t2
V=1//Input voltage(in volts)
R=10//Resistance(in kilo ohm)
C=0.1//Capacitance(in micro farad)
```

```
I=V*1000/R
T=1000/f
t1=T*c
vo=(I*t1)/(C*1000)
t2=T*p
Ir=C*vo*1000/t2
disp(Ir,'Required current(in micro ampere)=')
```

Chapter 15

Samping conversion modulation and multiplexing

Scilab code Exa 15.1 Determine the errors due to Rs and Rd

```
//Caption:Determine the errors due to Rs and Rd
//Ex15.1
clc;
clear;
close;
Vs=1//Source voltage(in volts)
Rs=100//Source resistance(in ohm)
Rl=10//Load resistance(in kilo ohm)
Rd=30//Drain resistance(in ohm)
Vgs=10//Gate source voltage(in volts)
V1=-(Vs+Vgs+1)
Id=Vs/(Rs+Rd+Rl)
e1=(Id*Rs)*100/(Vs)
e2=(Id*Rd)*100/(Vs)
disp(e2,e1,'Errors due to Rs(in %) and due to Rd(in
    %)=')
```

Scilab code Exa 15.2 Determine capacitance and minimum acquisition time

```
//Caption:Determine capacitance and minimum
    acquisition time
//Ex15.2
clc;
clear;
close;
Vs=1//Supply voltage(in volts)
a=0.25//Accuracy(in %)
t=500//Holding time(in micro sec)
Ib=500//Maximum base current(in nA)
Rd=30//Drain Resistance(in ohm)
v=Vs*0.1/100
C=Ib*t*10^(-9)/v
T=7*C*Rd
disp(T,C,'Required capacitance(in micro farad) and
    acquisition time(in micro sec)=')
```

Scilab code Exa 15.3 Determine the error due to capacitance

```
//Caption:Determine the error due to capacitance
//Ex15.3
clc;
clear;
close;
Vgs=10//Gate source voltage(in volts)
C=10.5//Capacitance(in pF)
Vs=1//Supply voltage(in volts)
C1=0.25//Capacitance(in micro farad)
V1=-(Vs+Vgs+1)
Vgsm=Vs-(V1)
Q=C*Vgsm
Vo=Q/C1
e=Vo*10^(-6)*100/Vs
```

```
disp(e,'Error due to capacitance(in %)=')
```

Scilab code Exa 15.4 `Calculate the output voltage`

```
//caption:Calculate the output voltage
//Ex15.4
clc;
clear;
close;
Vie=1//Input voltage for resistor Re(in volts)
Vid=0//Input voltage for resistor Rd(in volts)
Vic=1//Input voltage for resistor Rc(in volts)
Vib=1//Input voltag for resistor Rb(in volts)
Via=0//Input voltage for resistor Ra(in volts)
R=16//Input Resistor(in kilo ohm)
re=1//Resistor(in kilo ohm)
rd=2//Resistor(in kilo ohm)
rc=4//Resistor(in kilo ohm)
rb=8//Resistor(in kilo ohm)
ra=16//Resistor(in kilo ohm)
Vo=R*((Vie/re)+(Vid/rd)+(Vic/rc)+(Vib/rb)+(Via/ra))
disp(Vo,'Output voltage(in volts)=')
```