Scilab Manual for Electronic Devices And Circuits by Prof Mahesh M Electronics Engineering Sreenidhi Institute Of Science & Technology[1]

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Experiment: 1

Determine the base,emitter,collector current of Common Base config ,given alpha value

check Appendix AP 6 for dependency:

EX1.jpg

Scilab code Solution 1.1 1

```
1 //Determine the base,emitter,collector current of
    Common base config
2 //Windows 10
3 //Scilab 6.0.0
4
5 clc;
6 clear;
7 close;
8
9 alpha=0.95     //in Ampere
10 Rl=5*10e3     //in kilo ohms
```

```
Vd=4.5        //in volts
Ic=Vd/Rl      //Current flowing through resistor (or)
   Collector Current in milli Ampere
Ie=Ic/alpha    //emitter current in milli Ampere
Ib=Ie-Ic        //base current in micro Ampere
Ic1=Ic*10e3
Ib1=Ib*10e6
Ie1=Ie*10e3
mprintf('The value of Ib is %.1fuA',Ib1)
mprintf('\nThe value of Ic is %.1fmA',Ic1)
mprintf('\nThe value of Ie is %.3fmA',Ie1)
```

Experiment: 2

Determine operating point of Fixed Bias circuit ,given transistor gain,base to emitter voltage

check Appendix AP 5 for dependency:

EX2.jpg

Scilab code Solution 2.2 2

```
1 //Determine the operating point of Fixed Bias ckt
    given transistor gain,Vbe
2 //Windows 10
3 //Scilab 6.0.0
4
5 clc;
6 clear;
7 close;
8
9 tgain=100              //beta (or) transistor gain //
    unitless
```

```
Vcc=15                    //in volts
Vbe=0.7                  //base emitter voltage in volts
Rb=1*10e6                 //resistance in ohms
Rc=4*10e3                 //resistance in ohms
Ic=Vcc/Rc
Icq=tgain*((Vcc-Vbe)/Rb)     //collector current in
   milli Ampere
Vceq=Vcc-(Icq*Rc)     //collector emitter voltage in
   volts
Vce=Vcc-(Ic*Rc)                    //load line equation
    for fixed-bias ckt
//Substituting Ic=0,Vce=Vcc=15v
Ic1x=0
Vcex=Vcc-(Ic1x*Rc)
//coordinates of load line on x-axis are(0 mA,15V)
//Substituting Vce=0,Ic=Vcc/Rc=3.75mA
Vcey=0
Icy=Vcc/Rc
//coordinates of load line on y-axis are(3.75 mA,0V)
Icq=Icq*10e3
Vce=Vce*10e3
Icy=Icy*10e3
mprintf('Collector Current Icq=%.2fmA',Icq)
mprintf('\nCollector-Emitter Voltage Vceq=%.2fV',
   Vceq)
mprintf('\nX-Axis Coordinates(%dmA,%dV)',Ic1x,Vcex)
mprintf('\nY-Axis Coordinates(%.2fmA,%dV)',Icy,Vcey)
mprintf('\nOperating Point is Icq=%.2fmA and Vceq=%
   .2fV',Icq,Vceq)

//plotting the load line
x=[Ic1x,Vcex]
y=[Icy,Vcey]
clf()
plot(x,y)
xtitle('Load Line');
xlabel('Vce(V)');ylabel('Ic(mA)');
```

Experiment: 3

Determine ouput voltage of circuit given Vbe for transistors Q1,Q2

check Appendix AP 4 for dependency:

EX3.jpg

Scilab code Solution 3.3 3

```
1  //Determine output voltage of a ckt
2  //Windows 10
3  //Scilab 6.0.0
4
5  clc;
6  clear;
7  close;
8
9  Vcc=15            //in volts
10 Vbe2=0.7          //in volts
11 Vq1=1.7          //in volts
12 Rb1=1*10^3       //in kilo ohms
13 Rb2=100          //in ohms
```

```
Ie1=(Vq1-Vbe2)/Rb2
Ic1=Ie1
Vc1=Vcc-(Rb1*Ie1)
Q2=Vc1
Vb2=Vc1
Ve2=Vb2-Vbe2
Vout=Ve2
Ie1=Ie1*10^3      //in milli Ampere
mprintf('Ie1:%d mA',Ie1)
mprintf('\nVc1:%d V',Vc1)
mprintf('\nQ2:%d V',Q2)
mprintf('\nVe2:%.1f V',Ve2)
mprintf('\nVout:%.1f V',Vout)
```

Experiment: 4

Determine value of drain current Id and gate source voltage Vgs for self bias circuit

check Appendix AP 3 for dependency:

EX4.jpg

Scilab code Solution 4.4 4

```
1 //Determine value of drain current-Id and gate-
    source voltage-Vgs for self-bias ckt
2 //Windows 10
3 //Scilab 6.0.0
4
5 clc;
6 clear;
7 close;
8
9 Vdd=20                  //in Volts
10 Vds=15                 //in Volts
11 Rd=4*10^3              //in ohms
12 Rs=0.4*10^3            //in ohms
```

```
13 Id=(Vdd-Vds)/(Rd+Rs)          //in milli Ampere
14 Vgs=Id*Rs                  //in Volts
15 Id=Id*10^3
16 mprintf('Drain Current Id is %.2fmA',Id)
17 mprintf('\nGate-Source Voltage Vgs is %.3fV',Vgs)
```

Experiment: 5

Find Freq of RC phase shift oscillator if the 3 resistances are equal and 3 capacitances are equal

Scilab code Solution 5.5 5

```
1 //Given N-channel JFET determine the value of rs to
     achieve Self Bias condition
2 //Windows 10
3 //Scilab 6.0.0
4
5 clc;
6 clear;
7 close;
8
9 Idss=40*10^-3            //in milli Ampere
10 Vp=-10                  //in Volts
11 Vgs=-5                 //in Volts
12 Vds=5                  //in Volts
13 Id=Idss*((1-(Vgs/Vp))^2)
14 Rs=Vds/Id
```

```
15 Id=Id*10^3          //in milli Ampere
16 mprintf('Id is %dmA',Id)
17 mprintf('\nRs is %d ohms',Rs)
```

Experiment: 6

Given N-channel JFET determine the value of Rs to achieve self bias condition

Scilab code Solution 6.6 6

```
1 //Find freq. of RC phase shift oscillator
2 //Windows 10
3 //Scilab 6.0.0
4
5 clc;
6 clear;
7 close;
8
9 R1=200*10^3          //resistance 1 in kilo ohms
10 R2=200*10^3         //resistance 2 in kilo ohms
11 R3=200*10^3         //resistance 3 in kilo ohms
12 C1=100*10^-12          //capacitance 1 in pico
     farads
13 C2=100*10^-12         //capacitance 2 in pico farads
14 C3=100*10^-12        //capacitance 3 in pico farads
15 fr=1/(2*%pi*R1*C1*sqrt(6))
16 fr=fr*10^-3          //in kilo Hertz
```

```
17 mprintf('The freqency of RC phase shift oscillator
     is %f Hz',fr)
```

Experiment: 7

Find the capacitance value in Wien-bridge oscillator given value of R and Freq of oscillation

Scilab code Solution 7.7 7

```
1 //Find the capacitance value in Wien-bridge
     oscillator
2 //Windows 10
3 //Scilab 6.0.0
4
5 clc;
6 clear;
7 close;
8
9 R=100*10^3          //resistance in kilo ohms
10 fr=10*10^3         //frequency of oscillation in kilo
     hertz
11 C=1/(2*%pi*R*fr)
12 C=C*10^12         //in pico Farad
13 mprintf('The capacitance value in the Wien-bridge
```

```
oscillator is: %.2f pF',C)
```

Experiment: 8

Design Zener Shunt voltage regulator with given specifications

Scilab code Solution 8.8 8

```
1  //Design Zener Shunt-Voltage regulator
2  //Windows 10
3  //Scilab 6.0.0
4
5  clc;
6  clear;
7  close;
8
9  Vo=10        //in volts
10 Vinmin=20       //lowercase Vin in volts
11 Vinmax=30       //uppercase Vin in volts
12 Ilmin=30*10^-3        //lowercase Il in volts
13 Ilmax=50*10^-3        //uppercase Il in volts
14 Izmin=20*10^-3          //lowercase Iz in milli
     Ampere
15 Izmax=40*10^-3          //uppercase Iz in milli
     Ampere
```

```
Vz=Vo
Pz=Vz*Izmax
mprintf('Pz:%.2f W',Pz)
//Pz=0.4W, Hence a 0.5Z 10 zener can be selected
Rlmin=(Vo/Ilmax)
Rlmax=(Vo/Ilmin)
Rmax=((Vinmax-Vo)/(Ilmin+Izmax))
Rmin=((Vinmin-Vo)/(Ilmax+Izmin))
R=(Rmax+Rmin)/2
mprintf('\nRlmin:%d ohms',Rlmin)
mprintf('\nRlmax:%d ohms',Rlmax)
mprintf('\nRmax:%d ohms',Rmax)
mprintf('\nRmin:%d ohms',Rmin)
mprintf('\nR:%d ohms',R)
```

Experiment: 9

Determine input,output impedance voltage and current gain given h-parameters of transistor

check Appendix AP 2 for dependency:

EX9.jpg

Scilab code Solution 9.9 9

```
1 //Determine input&output impedance voltage and
    current gain given h-parameters of transistor
2 //Windows 10
3 //Scilab 6.0.0
4
5 clc;
6 clear;
7 close;
8
9 Ic=3*10^-3            //collector current in milli
    Ampere
```

```
hfe=60                  //beta value
Vcc=12                   //in Volts
Vbe=0.6                  //base emitter voltage in
   Volts
Rc=5.1*10^3             //resistance in kilo ohms
Rb=220*10^3            //resistance in kilo ohms
hie=500                //in ohms
Zi=hie
Zo=Rc
Av=(-hfe*Rc)/hie
mprintf('Av:%d',Av)
Al=-hfe
mprintf('\nAl:%d',Al)
//from re model
Ib=(Vcc-Vbe)/Rb
Ib1=Ib*10^6              //in micro Ampere
mprintf('\nIb:%.1f uA',Ib1)
Ie=hfe*Ib
Ie1=Ie*10^3             //in milli Ampere
mprintf('\nIe:%.3f mA',Ie1)
re=(26*10^-3)/Ie
mprintf('\nre:%.2f ohms',re)
Zi=hfe*re
mprintf('\nZi:%.1f ohms',Zi)
Zo=Rc
Zo=Zo*10^-3
mprintf('\nZo:%.1f k ohms',Zo)
Av=-Rc/re
mprintf('\nAv:%d',Av)
Al=-hfe
mprintf('\nAl:%d',Al)
```

Experiment: 10

Design Schmitt Trigger circuit using 2 silicon NPN transistors with given configuration

check Appendix AP 1 for dependency:

EX10.jpg

Scilab code Solution 10.10 10

```
1 //Design schmitt trigger ckt using 2 silicon npn
     transistors with given config
2 //Windows 10
3 //Scilab 6.0.0
4
5 clc;
6 clear;
7 close;
8
9 UTP=5                  //in volts
10 Vb2=5                 //in volts
11 Vbe=0.7               //in volts
12 Vcc=12                //in volts
```

```
LTP=3                  //in volts
Ic=2*10^-3            //in milli Amperes
Ic2=2*10^-3            //in milli Amperes
hfemin=100
UTP=Vb2
Ve=Vb2-Vbe
mprintf('\nVe:%.2f V',Ve)
Ie=Ic
Ie=Ie*10^3
mprintf('\nIe:%d mA',Ie)
Re=Ve/Ie
mprintf('\nRe:%.2f k ohms',Re)
//taking q2 saturated
Vcesat=0.2              //in volts
IcRc2=Vcc-Ve-Vcesat
mprintf('\nIcRc2:%.1f V',IcRc2)
Rc2=(Vcc-Ve-Vcesat)/Ic
Rc2=Rc2*10^-3
mprintf('\nRc2:%.2f k ohms',Rc2)
I2=0.1*Ic2
I2=I2*10^3
mprintf('\nI2:%.2f mA',I2)
R2=Vb2/I2
mprintf('\nR2:%d k ohms',R2)
Ib2=Ic2/hfemin
Ib2=Ib2*10^6
mprintf('\nIb2:%d uA',Ib2)
I1=I2+Ib2
//substituting the values and equating I1
//(Vcc-Vb2)/(Rc1+R1)=I1=0.2*10^-3+20*106-6
//12-5/(Rc1+R1)=0.22*10^-3
Rc1r1=(Vcc-Vb2)/I1
//Rc1+R1=7/(0.22*10^-3)
//when q1 is on Vi=LTP=Vb2=3v
Vi=LTP
Vb1=3
Vb2=3
I1=Vb2/R2
```

```
//I1=I1*10^3
mprintf('\nI1:%.2f mA',I1)
Ie=(Vb1-Vbe)/Re
Ic1=Ie
mprintf('\nIc1:%.2f mA',Ic1)
mprintf('\nIe:%.2f mA',Ie)

//Vcc=Rc1(Ic1+I1)+I1(R1+R2)
Rc1=(Vcc-I1*(Rc1r1+R2))/(Ie)
Rc1=Rc1*10^-3
R1=Rc1r1-Rc1
//Rb<hfeRe
Rb=(hfemin*Re)/10
mprintf('\nRb:%.2f k ohms',Rb)
```

Appendix

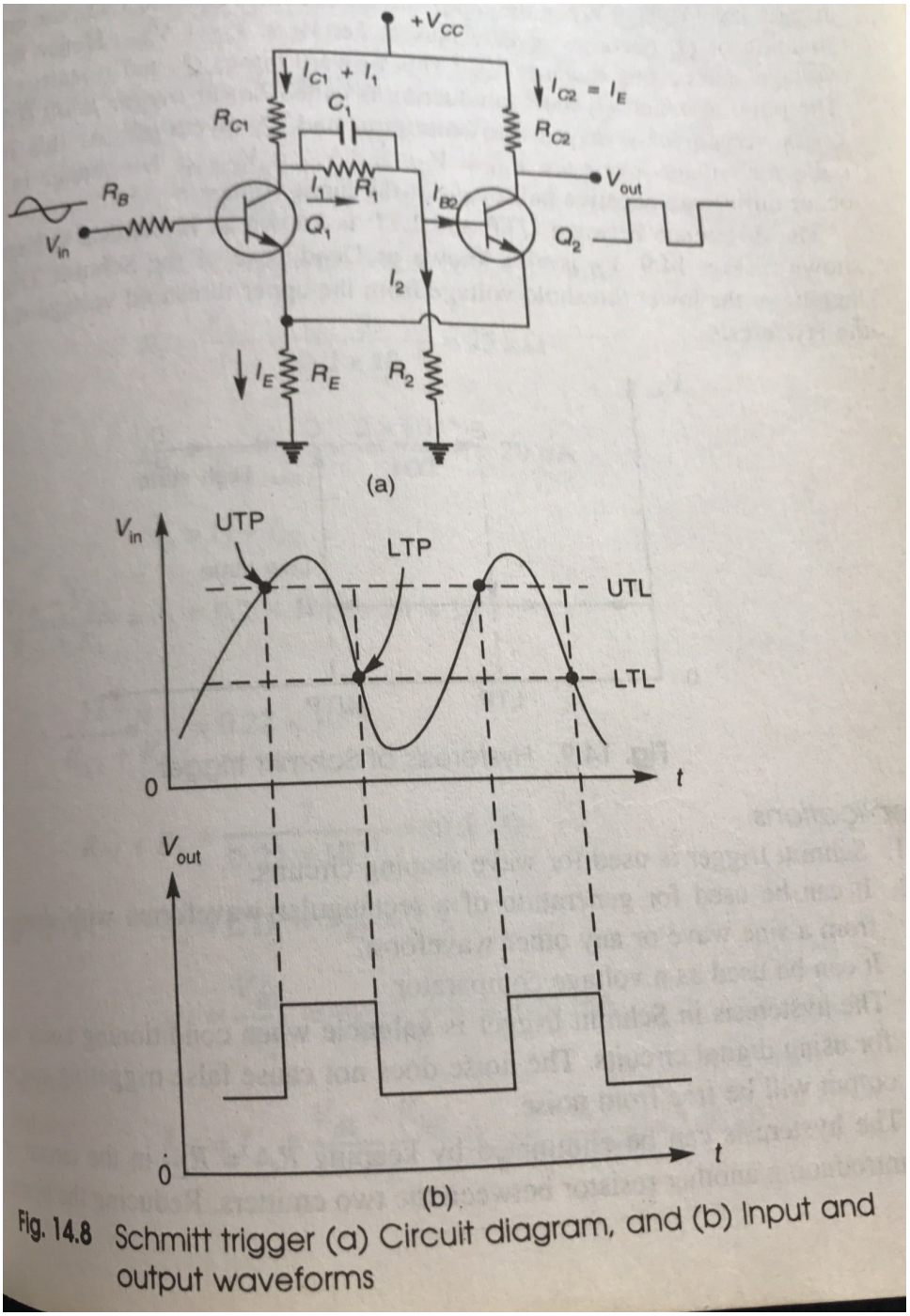


Fig. 14.8 Schmitt trigger (a) Circuit diagram, and (b) Input and output waveforms

Fig6

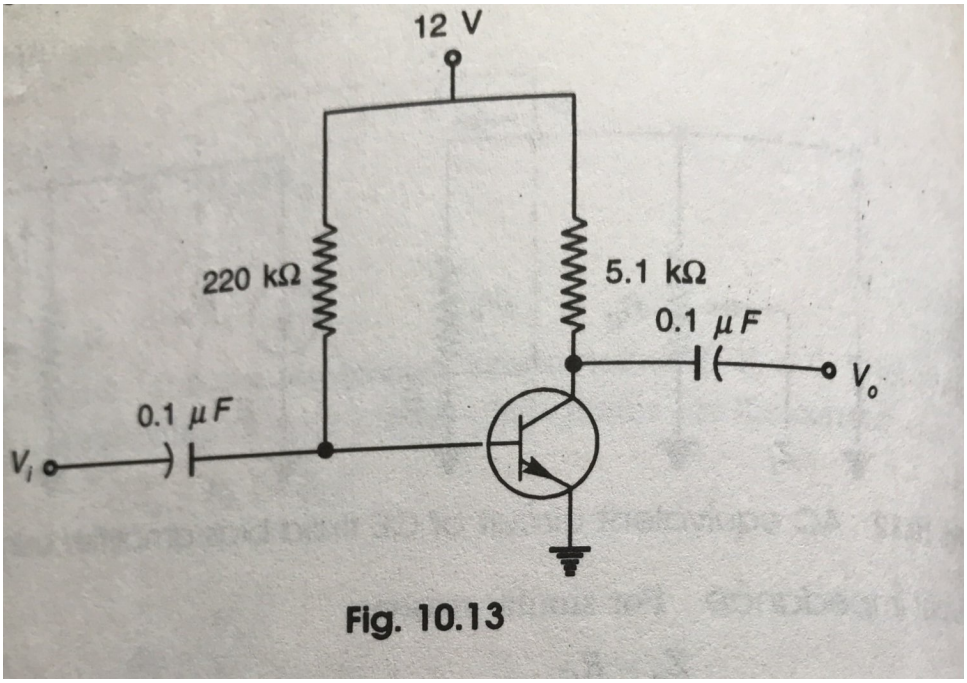


Fig. 10.13

Fig5

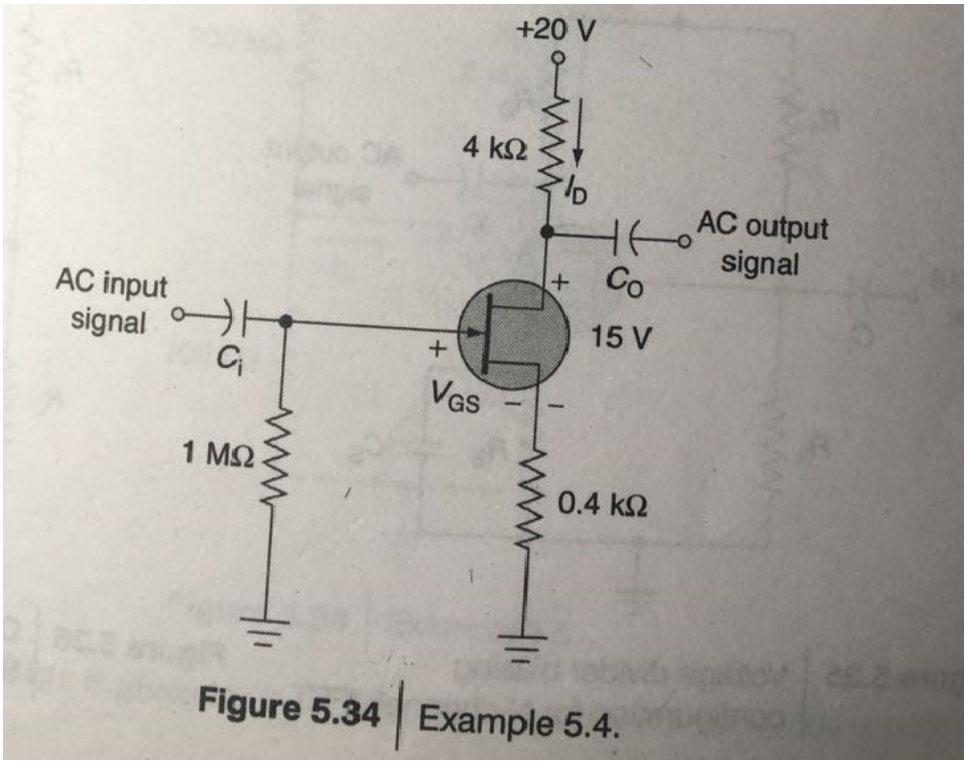


Figure 5.34 | Example 5.4.

Fig4

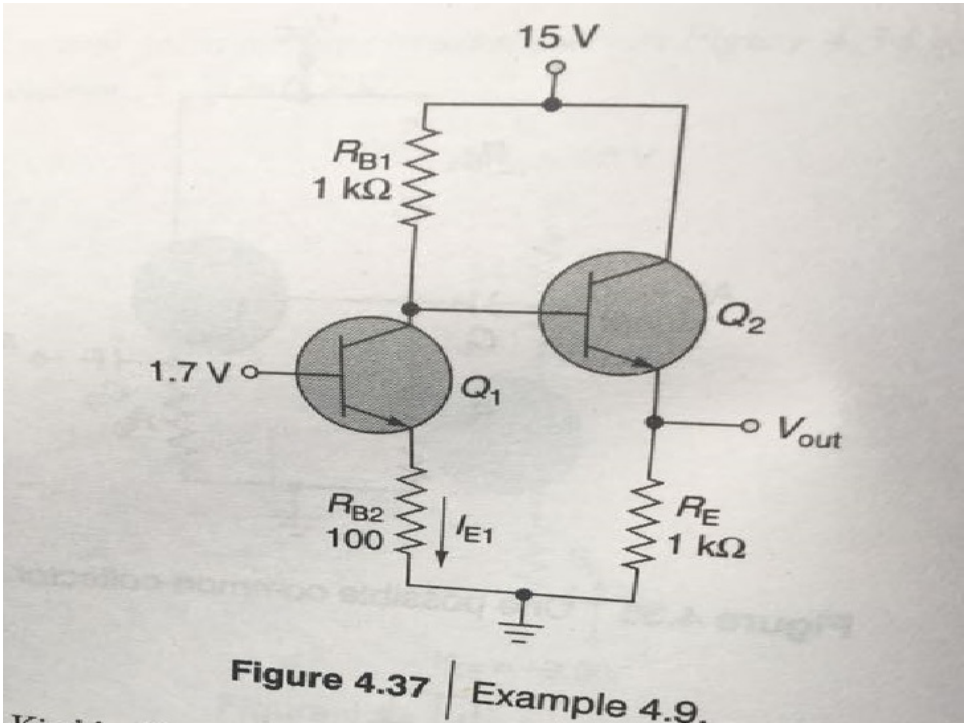


Figure 4.37 | Example 4.9.

Fig3

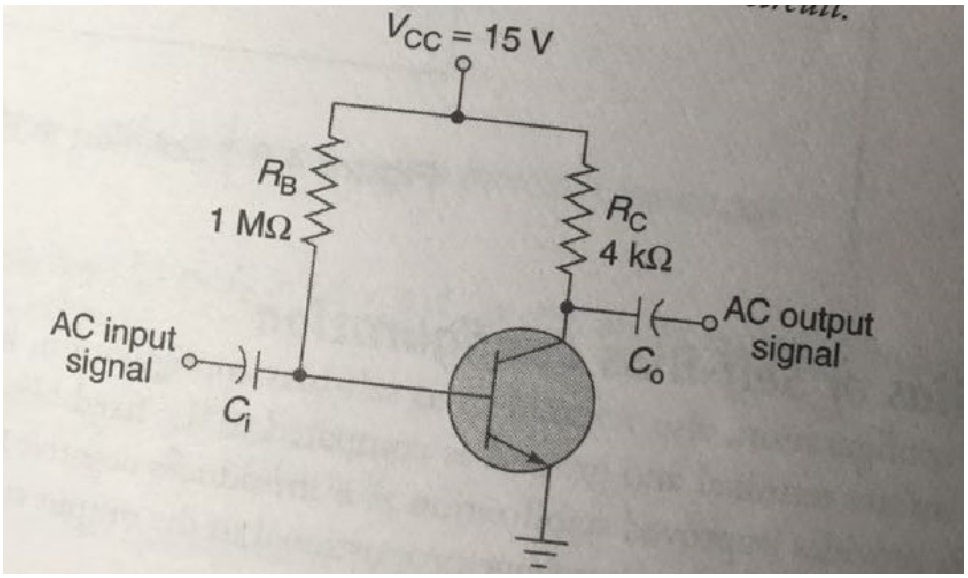


Fig2

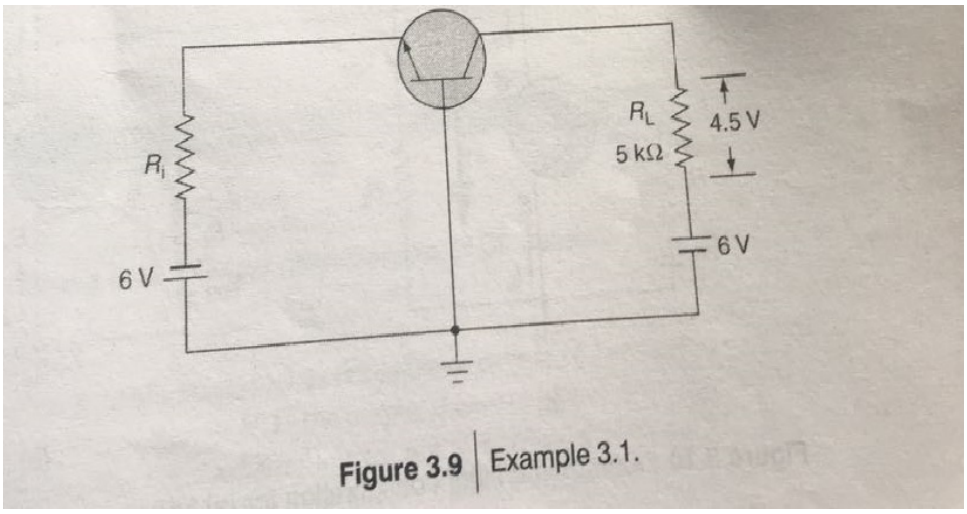


Figure 3.9 | Example 3.1.

Fig1