Scilab Textbook Companion for Solid State Devices And Circuits by S. Sharma[1]

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May 24, 2016

[1]Funded by a grant from the National Mission on Education through ICT, http://spoken-tutorial.org/NMEICT-Intro. This Textbook Companion and Scilab codes written in it can be downloaded from the "Textbook Companion Project" section at the website http://scilab.in

Book Description

Title: Solid State Devices And Circuits

Author: S. Sharma

Publisher: S. K. Kataria And Sons, New Delhi

Edition: 5

Year: 2007

ISBN: 81-88458-35-5

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

Special diodes

Scilab code Exa 1.1 resistance

```
// Example 1.1: resistance
clc, clear
Iz=10*10^-3; // reverse current in ampere
Vz=0.05; // zener voltage in volts
Rz=Vz/Iz; // resistance in ohm
disp(Rz,"resistance (ohm) = ");
```

Scilab code Exa 1.2 terminal voltage

```
// Example 1.2: terminal voltage
clc, clear
v=4.7; // in volts
r=15; // in ohm
i=20*10^-3; // in ampere
Vz=(v+(i*r)); // terminal voltage in volts
disp(Vz,"terminal voltage in volts(v)");
```

Scilab code Exa 1.3 tunning range

```
// Example 1.3: tuning range of the circuit
clc, clear
C1=5*10^-12; // minimum capacitance in  farad
C2=50*10^-12; // maximum capacitance in  farad
L=10*10^-3; // in henry
CTmin= (C1/2);//minimum total capacitance of
   varactor diode
p= (sqrt(L*CTmin)); // calculating square root
q= (2*3.14*p);
fomax= (1/q); // maximum resonant frequency
CTmax= ((C2*C2)/(C2+C2));//maximum total capacitance
    of varactor diode
r= (sqrt(L*CTmax)); // calculating square root
s= (2*3.14*r);
fomin= (1/s); // minimum resonant frequency
disp(fomax,"maximum resonant frequency in(Hz)");
disp(fomin,"minimum resonant frequency in(Hz)");
```

Scilab code Exa 1.4 resistance

```
// Example 1.3: standard resistor
clc, clear
vf=1.8; // in volts
if=16*10^-3; // in ampere
vo=8; // in volts
rs=(vo-vf)/if; // resistor in ohm
disp(rs,"standard resistor (ohm) = ")
```

Scilab code Exa 1.5 LED Current

```
// Example 1.5: min and max value of led current
```

```
clc, clear
v1=1.5; // in volts
v2=2.3; // in volts
vs=10; // in volts
r1=470; // in ohm
I1=(vs-v1)/r1; // in ampere
I2=(vs-v2)/r1; // in ampere
disp(I1,"maximum current in ampere (A) = ")
disp(I2,"minimum current in ampere (A) = ")
```

Scilab code Exa 1.6 supply voltage

```
// Example 1.6: which supply voltage will keep brighness of diode constant
clc, clear
v1=1.8; // in volts
v2=3; // in volts
vs=24; // in volts
rs=820;// in ohms
Imin=((vs-v2)/rs);//case1
Imax=((vs-v1)/rs);
vs1=5; // in volts
rs1=120;// in ohms
Imin1=((vs1-v2)/rs1);//case2
Imax1=((vs1-v1)/rs1);
r1=470; // in ohmI1=(vs-v1)/r1; // in ampere
disp(Imax,"maximum current in ampere in case1(A) = ")
disp(Imin,"minimum current in ampere in case1(A) = ")
disp(Imax1,"maximum current in ampere in case2(A) = ")
disp(Imin1,"minimum current in ampere in case2(A) = ")
disp("Brightness in the first case will remain
```

```
    constant wheras in second case it will be
    changing ,therefore , in order to get an
    approximately constant brighntness we use as
    large a supply voltage as possible")
```

Scilab code Exa 1.7.a photocurrent

```
// Example 1.7.a : photocurrent
clc, clear
r=0.85; // reponsivity of a photodiode in apmere per
    watt
p1=1; // incident light power in milli watt
Ip=r*p1;
disp(Ip,"photocurrent (mA) = ")
```

Scilab code Exa 1.7.b photocurrent

```
// Example 1.7.b : photocurrent
clc, clear
r=0.85; // reponsivity of a photodiode in apmere per
    watt
p1=2; // incident light power in milli watt
disp("Given input power saturation is 1.5mw so Ip is
    not proportional to Pop hencewe cannot find the
    value of photocurrent")
```

Scilab code Exa 1.8 quantum efficiency

```
// Example 1.8: quantum efficiency
clc, clear
```

```
EHP=5.4*10^6;
photons=6*10^6;
n=EHP/photons;
disp(n,"quantum efficiency = ")
```

Scilab code Exa 1.9 responsivity

```
h=6.62*10^-34;// planc's constant
c=3*10^8;// speed of light in vaccum
e=0.70;//efficiency
Eg=0.75*1.6*10^-19;// Energy gap in volts
w=((h*c)/Eg);//wavelength in meters
R=((e/1248)*w);// in ampere per watt
disp (R , "Responsivity = ")
```

Chapter 2

Bipolar Junction Transistors

Scilab code Exa 2.1 Common base d c current

```
// Example 2.1: comman base dc current gain
clc, clear
Ic=2.10*10^-3; // collector current in ampere
Ie=2.18*10^-3; // emitter current in ampere
alfa=Ic/Ie;
disp(alfa,"comman base dc current gain")
```

Scilab code Exa 2.2 base current

```
// Example 2.2: Base Current
alfa= 0.987;// Common base D.C. Current Gain
Ie= 10;//in Milli Ampere
Ic= alfa*Ie ; // Collector Current
Ib=Ie-Ic;// Base Current in Mili Ampere
disp(Ic,"collector current (in mA)")
disp(Ib,"base current (in mA)")
```

Scilab code Exa 2.3 collector current and base current

```
// Example 2.3: Calculate base current and collector
   current
alfa= 0.967;// Common base D.C. Current Gain
Ie= 10;//in Milli Ampere
Ic= alfa*Ie ; // Collector Current
Ib=Ie-Ic;// Base Current in Mili Ampere
disp(Ic,"collector current (in mA)")
disp(Ib,"base current (in mA)")
```

Scilab code Exa 2.4 collector and base current

```
// Example 2.4: Calculate base current and collector
   current
Beta=100;//Common Emitter D.C. Current gain
Ie=10;// Emitter current in mili ampere
alfa= (Beta/(Beta+1));//Common Base D.C. Current
  gain
Ic= alfa*Ie;// Collector current in milli ampere
Ib=Ie-Ic;// Base Current in milli ampere
disp(Ic,"Collector current (in mA)")
disp(Ib,"Base current (in mA)")
```

Scilab code Exa 2.5.a dc current gain

```
// Example 2.5.a: Calculate Common Emitter D.C.
  Current gain
alfa=0.950;//Common base D.C. Current gain
beta= (alfa/(1-alfa));
disp(beta,"Common Emitter D.C. Current gain")
```

Scilab code Exa 2.5.b ac current gain

```
// Example 2.5.b: Calculate Common Base D.C. Current gain
Beta=100;//Common emitter D.C. Current gain
alfa= (Beta/(1+Beta));
disp(alfa,"Common Base D.C. Current gain")
```

Scilab code Exa 2.6 collector and base current

```
// Example 2.6: Calculate base current and collector current
Beta=100;//Common Emitter D.C. Current gain
Ie=10;// Emitter current in mili ampere
Ib=(Ie/(1+Beta));//Emitter current in mili amperen mA
Ic= Ie-Ib;//Collector current in mili amperen mA
disp(Ib,"Base current (in mA)")
disp(Ic,"Collector current (in mA)")
```

Scilab code Exa 2.7 dc load line

```
// Example 2.7: Calculate the collector to emitter voltage(Vce) and Collector current (Ic)
clc;
clear;
Vcc= 12 ;// as Ic=0 so Vce=Vcc (In volts)
Rc= 3;// Collector Resistance in killo oms
Ic=Vcc/Rc; // Collector Current in Amperes
```

```
Vce=Vcc;
disp(Vce,"Colletor to emitter voltage (in volts)")
disp(Ic," Collector current (in mA)")
```

Scilab code Exa 2.8.a operating point

```
// Example 2.8.A: Calculate oerating point
Vcc=6;// Colector voltage in volts
Rb= 530;// in kilo ohms
Beta=100;//Common emitter D.C. Current gain
Rc=2;// Collector resistance in killo ohms
Vbe= 0.7;// Base to emitter voltage in volts
Ib= ((Vcc-Vbe)/Rb); //in micro amperes
Ic=Beta*Ib;//in milli ampere
Vce= Vcc-(Ic*Rc); //Colector to emitter voltage in
   volts
disp ("Operating point is (Vce,Ic)")
disp(Vce,"In Volts")
disp(Ic,"in mA")
```

Scilab code Exa 2.8.b stability factor

```
// Example 2.8.b: Calculate stability factor
Beta=100;//Common emitter D.C. Current gain
S=1+Beta ;
disp (S,"The Stability factor")
```

Scilab code Exa 2.9.a base current

```
// Example 2.9.a: Calculate base current
```

```
Vcc=20;// Colector voltage in volts
Rb= 200;// in kilo ohms
Beta=75;//Common emitter D.C. Current gain
Rc=0.8;// Collector resistance in killo ohms
Vbe= 0;// Base to emitter voltage in volts
Ib=Vcc/Rb;
disp(Ib,"Base current in mA")
```

Scilab code Exa 2.9.b collector current

```
// Example 2.9.B: Calculate collector current
Vcc=20;// Colector voltage in volts
Rb= 200;// in kilo ohms
Beta=75;//Common emitter D.C. Current gain
Rc=0.8;// Collector resistance in killo ohms
Vbe= 0;// Base to emitter voltage in volts
Ib=0.1;// Base current in mA
Ic=Beta*Ib;// Collector current in mA
disp(Ic,"Collector current in mA")
```

Scilab code Exa 2.9.c collector to emitter voltage

```
// Example 2.9.C: Calculate collector TO emitter
   voltage
Vcc=20;// Colector voltage in volts
Rb= 200;// in kilo ohms
Beta=75;//Common emitter D.C. Current gain
Rc=0.8;// Collector resistance in killo ohms
Vbe= 0;// Base to emitter voltage in volts
Ib=0.1;// Base current in mA
Ic=7.5;// Base current in mA
Vce=Vcc- (Ic*Rc)
disp(Vce,"Collector to emitter voltage in volts")
```

Scilab code Exa 2.9.d stability factor

```
// Example 2.9.C: Calculate collector TO emitter
   voltage
Vcc=20;// Colector voltage in volts
Rb= 200;// in kilo ohms
Beta=75;//Common emitter D.C. Current gain
Rc=0.8;// Collector resistance in killo ohms
Vbe= 0;// Base to emitter voltage in volts
S=1+Beta ;
disp (S,"The Stability factor")
```

Scilab code Exa 2.10.a ground and stability factor

```
// Example 2.10: Calculate base resistance , Voltage
    between collector & ground and Stability factor
Vcc=12;// Colector voltage in volts
Ib= 0.3;// in mili ampere
Beta=100;//Common emitter D.C. Current gain
Rc=0.3;// Collector resistance in killo ohms
Rb=Vcc/Ib;
Ic= Beta*Ib;
Vce=Vcc -(Ic*Rc);
S=1+Beta ;
disp(Rb,"Base resistance in killo ohms")
disp(Vce,"Collector to ground voltgae in volts")
disp (S,"The Stability factor")
```

Scilab code Exa 2.11 DC Bias voltages and currents

```
// Example 2.11: Calculate base current , Collector
   current and Collector to emitter voltage
Vcc=20;// Colector voltage in volts
Rb= 400;// in KILLO OHMS
Beta=100;//Common emitter D.C. Current gain
Rc=2;// Collector resistance in killo ohms
Re=1;// Emitter resistance in killo ohms
Ib= Vcc / (Rb + (Beta*Re));
Ic= Beta*Ib;
Vce=Vcc -(Ic*(Rc+Re));
disp(Ib,"Base current in mA")
disp(Ic,"Collector current in mA")
disp(Vce,"Collector to ground voltgae in volts")
```

Scilab code Exa 2.12 collector current collector to emitter voltage and stability factor

```
// Example 2.12: Calculate  Collector current and
   Collector to emitter voltage
Vcc=25;// Colector voltage in volts
Vbe=0.7;// Base to emitter voltage  in volts
Rb= 180;// in KILLO OHMS
Beta=80;//Common emitter D.C. Current gain
Rc=0.82;// Collector resistance in killo ohms
Re=0.2;// Emitter resistance in killo ohms
Ic= (Vcc-Vbe)/(Re + (Rb/Beta));
Vce=Vcc -(Ic*(Rc+Re));
disp(Ic,"Collector current in mA")
disp(Vce,"Collector to ground voltgae in volts")
```

Scilab code Exa 2.13 colector current collector to emitter voltage and stability factor

```
// Example 2.13: Calculate  Collector current , Collector to emitter voltage and stability factor
Vcc=20;// Colector voltage in volts
Vbe=0.7;// Base to emitter voltage  in volts
Rb= 200;// in KILLO OHMS
Beta=100;//Common emitter D.C. Current gain
Rc=20;// Collector resistance in killo ohms
Ic= (Vcc-Vbe)/(Rc + (Rb/Beta));
Vce=Vcc -(Ic*Rc);
S=(1+Beta)/(1+Beta*(Rc/(Rc+Rb)));
disp (S,"The Stability factor")
disp(Ic,"Collector current in mA")
disp(Vce,"Collector to ground voltgae in volts")
```

Scilab code Exa 2.14 base current collector current and stability factor

```
// Example 2.14: Calculate  base current , Collector current  , Collector to emitter voltage and stability factor
Vcc=10;// Colector voltage in volts
Vbe=0;// Base to emitter voltage  in volts
Rb= 100;// in KILLO OHMS
Beta=100;//Common emitter D.C. Current gain
Rc=10;// Collector resistance in killo ohms
Ib= (Vcc-Vbe)/(Rb+ Beta*Rc);
Ic= Beta * Ib;
Vce=Vcc -(Ic*Rc);
S=(1+Beta)/(1+Beta*(Rc/(Rc+Rb)));
disp(Ib,"base current in mA")
disp(Ic,"Collector current in mA")
disp(Vce,"Collector to ground voltgae in volts")
disp (S,"The Stability factor")
```

Scilab code Exa 2.15 emitter current collector current and collector to emitter voltage

```
// Example 2.15: Calculate emitter current , Collector current  and Collector to emitter voltage
Vcc=10;// Colector voltage in volts
Vbe=0.7;// Base to emitter voltage  in volts
Vee=10;// emitter voltage  in volts
Rb= 50;// in KILLO OHMS
Beta=100;//Common emitter D.C. Current gain
Rc=1;// Collector resistance in killo ohms
Re=5;// Emitter resistance in killo ohms
Ie= (Vee-Vbe)/Re;
Ic= Ie
Vce1=Vcc -(Ic*Rc);
Ve=-Vbe;
Vce=Vce1-Ve
disp(Ie,"Emitter Current in mA")
disp(Ic,"Collector current in mA")
disp(Vce,"Collector to ground voltgae in volts")
```

Scilab code Exa 2.16 change in q point

```
// Example 2.16: Calculate the change in q point
Vcc=20;// Colector voltage in volts
Vbe1=0.7;// Base to emitter voltage  in volts
Vee=20;// emitter voltage  in volts
Rb= 10;// in KILLO OHMS
Beta1=50;//Common emitter D.C. Current gain
Rc=5;// Collector resistance in killo ohms
Re=10;// Emitter resistance in killo ohms
Ie1= (Vee-Vbe1)/(Re+(Rb/Beta1));
Ic1=Ie1;
Vce1a=Vcc -(Ic1*Rc);
```

```
Ve=-Vbe1;
Vce1=Vce1a-Ve
disp(Ie1,"Emitter Current in first case in mA")
disp(Vce1,"Collector to ground voltgae in in first
   case in volts")
Vbe2=0.6;// Base to emitter voltage  in volts
Beta2=50;//Common emitter D.C. Current gain
Ie2= (Vee-Vbe2)/(Re+(Rb/Beta2));
Ic2=Ie2;
Vce2a=Vcc -(Ic2*Rc);
Ve=-Vbe2;
Vce2=Vce2a-Ve
disp(Ie2,"Emitter Current in second case in mA")
disp(Vce2,"Collector to ground voltgae in in first
   case in volts")
detaIc= ((1.921-1.892)/1.892)*100;
detaVce=((Vce1-Vce2)/Vce2)*100;
disp(detaIc,"Change in collector current in %")
disp(detaVce,"Change in collector to emitter voltage
    in %")
```

Scilab code Exa 2.17 input resistance

```
// Example 2.17: Calculate dynamic input resistance
deltaVbe=200;// in milli volts
deltaIe=5;// in milli ampere
Ri=deltaVbe/deltaIe;
disp(Ri,"Dyanamic input resistance is (in ohms)")
```

Scilab code Exa 2.18 base current collector current and collector to emitter voltage

```
// Example 2.18: Calculate base current ,collector
   current , Collector to emitter voltage ,colletcor
    voltage ,base voltage and collector to base
   voltage
Vcc=15;// Colector voltage in volts
Rb= 180;// in kilo ohms
Beta=100;//Common emitter D.C. Current gain
Rc=1.5;// Collector resistance in killo ohms
Vbe= 0.7;// Base to emitter voltage in volts
Ib= ((Vcc-Vbe)/Rb); //in milli amperes
Ic=Beta*Ib;//in milli ampere
Vce= Vcc-(Ic*Rc); //Colector to emitter voltage in
   volts
Vc=Vce;
Vb=Vbe;
Vcb=Vc-Vb;
disp (Ib,"base current in milli Ampere")
disp (Ic,"Collector current in milli Ampere")
disp(Vce,"Coolector to emitter voltage In Volts")
disp(Vc,"Coolector voltage In Volts")
disp(Vb,"Base voltage In Volts")
disp(Vcb,"Coolector to base voltage In Volts")
```

Scilab code Exa 2.19 operating point and stability factor

```
// Example 2.19: Operating point , stability factor
clc;
clear;
close;
Vcc=10;// Colector voltage in volts
Rb= 930;// in kilo ohms
Beta=100;//Common emitter D.C. Current gain
Rc=4;// Collector resistance in killo ohms
Vbe= 0.7;// Base to emitter voltage in volts
Ib= ((Vcc-Vbe)/Rb); //in milli amperes
```

```
Ic=Beta*Ib;//in milli ampere
Vce= Vcc-(Ic*Rc); //Colector to emitter voltage in
    volts
S=(1+Beta);
disp ("Operating point is (Vce,Ic) ")
disp(Vce,"Coolector to emitter voltage In Volts")
disp (Ic,"Collector current in milli Ampere")
disp (S,"The Stability factor")
```

Scilab code Exa 2.20 resistance and stability factor

```
// Example 2.20: Base Resistance , stability factor
clc;
clear;
close;
Vcc=20;// Colector voltage in volts
Beta=100;//Common emitter D.C. Current gain
Rc=1;// Collector resistance in killo ohms
Vce=4;// Collector to emitter voltage in volts
Ic= ((Vcc-Vce)/Rc); //in milli amperes
Ib=Ic/Beta;//in milli ampere
Rb=Vce/Ib;//in Killo ohms
S=(1+Beta)/(1+Beta*(Rc/(Rc+Rb)));
disp (Rb,"Base resistance in killo ohms")
disp (S,"The Stability factor")
```

Scilab code Exa 2.21 quiescent point and stability factor

```
// Example 2.21: Quiescent , stability factor
clc;
clear;
close;
Vcc=10;// Colector voltage in volts
```

```
Beta=50; //Common emitter D.C. Current gain
Rc=2; // Collector resistance in killo ohms
Rb= 100; // in kilo ohms
Vbe=0; // Base to emitter voltage in volts
Ic= (Vcc-Vbe)/(Rc+(Rb/Beta)); //in milli amperes
Ib=Ic/Beta; //in milli ampere
Vce= Vcc-(Ic*Rc); //Colector to emitter voltage in volts
S=(1+Beta)/(1+Beta*(Rc/(Rc+Rb)));
disp ("Operating point is (Vce,Ic) ")
disp(Vce,"Colector to emitter voltage In Volts")
disp (Ic,"Collector current in milli Ampere")
disp (S,"The Stability factor")
```

Scilab code Exa 2.22 Collector to emitter bias voltage

```
// Example 2.22: Collector to emitter bias voltage
clc;
clear;
close;
Vcc=20; // Colector voltage in volts
Beta=100; //Common emitter D.C. Current gain
Rc=2; // Collector resistance in killo ohms
Rb= 100; // in kilo ohms
Vbe=0.7; // Base to emitter voltage in volts
Ic=10; //in milli amperes
Ib=Ic/Beta; //in milli ampere
Vce= Vbe+(Ib*Rb); //Colector to emitter voltage in volts
disp(Vce,"Colector to emitter voltage In Volts")
disp (Ib,"Base current in milli Ampere")
```

Scilab code Exa 2.23 base and collector resistance

```
// Example 2.23: Base Currecnt ,Collector current
clc;
clear;
close;
Icbo=0;//collecttor to base leakage current
Vcc=9;// Colector voltage in volts
Beta=100;//Common emitter D.C. Current gain
Vce=5;// Collector to emitter voltage in volts
Ic=0.2; //in milli amperes
Rc=(Vcc-Vce)/Ic;;// Collector Reesistance in ohms
Ib=Ic/Beta;//in milli ampere
Rb=Vce/Ib;;//Base resistance in  ohms
disp(Rc,"Collector Reesistance in ohms")
disp (Rb,"Base resistance in ohms")
```

Scilab code Exa 2.24 resistance and stability factor

```
// Example 2.24: Base Resistance , stability factor
clc;
clear;
close;
Vcc=24;// Colector voltage in volts
Beta=45;//Common emitter D.C. Current gain
Rl=10;// Collector resistance in killo ohms
Re=0.27;// Emitter resistance in killo ohms
Vce=5;// Collector to emitter voltage in volts
Vbe=0.6;// Base to emitter voltage in volts
Ib=(Vcc-Vce)/((1+Beta)*(Rl+Re));//in milli ampere
Ic=Ib/Beta;// in micro ampere
R=(Vce-Vbe)/Ib;// Resistance in killo ohms
S=(1+Beta)/(1+Beta*(Re/(Re+R)));
disp (R,"Base resistance in killo ohms")
disp (S,"The Stability factor")
```

Scilab code Exa 2.25 operating point and stability factor

```
// Example 2.25: Quiescent , stability factor
clc;
clear;
close;
Vcc=16;// Colector voltage in volts
alfa=0.985;
Rc=3;// Collector resistance in killo ohms
Re= 2;// in kilo ohms
R1= 56;// in kilo ohms
R2= 20;// in kilo ohms
Vbe=0.3;// Base to emitter voltage in volts
Beta= alfa/(1-alfa);
Vb=Vcc * (R2/(R1+R2)); // vOLTAGE AT BASE
Ic= (Vb-Vbe)/Re; //in milli amperes
Ib=Ic/Beta;//in milli ampere
Vce= Vcc-(Ic*(Rc+Re)); //Colector to emitter voltage
    in volts
Rth= (R1*R2)/(R1+R2);
S=((1+Beta)*(1+Rth/Re))/(1+Beta+Rth/Re);
disp ("Operating point is (Vce,Ic) ")
disp(Vce,"Colector to emitter voltage In Volts")
disp (Ic,"Collector current in milli Ampere")
disp (S,"The Stability factor")
```

Scilab code Exa 2.26 resistance

```
// Example 2.26.a: Find R1,R2 & Re
clc;
clear;
close;
```

```
Vcc=10;// Colector voltage in volts
Beta=50;//Common emitter D.C. Current gain
Rc=2;// Collector resistance in killo ohms
Vce=4;// Collector to emitter voltage in volts
Vbe=0.3;// Base to emitter voltage in volts
Ic=2;//Collector current in milli Ampere
Ib=Ic/Beta;//Base current in milli ampere
I1=10*Ib;//
Ie=Ic;// Emitter current in mili ampere
Re=(Vcc-Ic*Rc-Vce)/Ic;//Emiier Resistance
V2=Vbe+Ic*Re;//Voltage across R2
R2=V2/I1;
R1=25-R2;
disp(R1,"resistance in killo ohms")
disp(R2,"resistance in killo ohms")
disp(Re,"emitter resistance in killo ohms")
```

Scilab code Exa 2.27 resistance

```
// Example 2.27: Find R
clc;
clear;
close;
Vcc=24;// Colector voltage in volts
Beta=45;
Rc=10;// Collector resistance in killo ohms
Re= 0.27;// in kilo ohms
Vce=5;// Collector to emitter voltage in volts
Vbe=0.6;// Base to emitter voltage in volts
Ib=(Vcc-Vce)/((1+Beta)*(Rc+Re));//in milli ampere
Ic=Ib/Beta;// in micro ampere
R=(Vce-Vbe)/Ib;// Resistance in killo ohms
disp (R,"Base resistance in killo ohms")
```

Scilab code Exa 2.28 collector current and collector to emitter voltage

```
// Example 2.28: Ic ,Vce
clc;
clear;
close;
Vcc=22;// Colector voltage in volts
Beta=40;
Rc=10;// Collector resistance in killo ohms
Re= 1.5;// in kilo ohms
R1= 40;// in kilo ohms
R2= 4;// in kilo ohms
Vbe=0.5;// Base to emitter voltage in volts
Vb=Vcc * (R2/(R1+R2)); // vOLTAGE AT BASE
Ic= (Vb-Vbe)/Re; //in milli amperes
Ib=Ic/Beta;//in milli ampere
Vce= Vcc-(Ic*(Rc+Re)); //Colector to emitter voltage
    in volts
disp(Vce,"Colector to emitter voltage In Volts")
disp (Ic,"Collector current in milli Ampere")
```

Scilab code Exa 2.29 voltage

```
// Example 2.29:Voltage across Re
clc;
clear;
close;
Vcc=20;// Colector voltage in volts
Beta=50;
R1= 60;// in kilo ohms
R2= 30;// in kilo ohms
Vbe=0.6;// Base to emitter voltage in volts
```

```
Vb=Vcc * (R2/(R1+R2)); // vOLTAGE AT BASE
Ve=Vb-Vbe;
disp(Ve,"voltage across Re In Volts")
```

Scilab code Exa 2.30 Collector resistance

```
// Example 2.30:Voltage across Re
clc;
clear;
close;
Vcc=10;//in volts
Rb=200;//Base resistance in killo ohms
Vbe=0.8;// Base to emitter voltage in volts
Beta=100;
Vce=0.2;// Collector to emitter voltage in volts
Ib=5/Rb;// Base current in milli ampere
Ic=Beta*Ib;// Collector current in milli ampere
Rc= (Vcc-Vce)/Ic;// Resistance
disp(Rc,"Collector resistance in killo ohms")
```

Scilab code Exa 2.31 collector voltage and emitter resistor

```
// Example 2.31 Cut off ,Vc & Re
clc;
clear;
close;
Vcc=10;//in volts
Rc=3;// Collector resistance in killo ohms
Rl=0.5;// in kilo ohms
Rb=7;// in kilo ohms
Beta=100;//Common emitter D.C. Current gain
Vbe=0.8;// Base to emitter voltage in volts
Ic=2.78;// in mA Applying KVL
```

```
Ib=0.1;// in mA Applying KVL
Ibmin=Ic/Beta;
Vc=Vbe;//in saturation region
Vce=Vc-Rl*(Ic+Ib);
Re=((Vcc-Vce)/Ic)-Rc;
disp(Ib,"Base current in mA")
disp(Ibmin,"Minimum Base  current  in mA")
disp("As Base current is more than minimum base
   current so it is in saturation region")
disp(Re,"Emitter resistance in killo ohms")
```

Scilab code Exa 2.32 Beta collecor voltage and base resistance

```
// Example 2.32:Beta ,Vcc & Rb
clc;
clear;
close;
Rc=2.7;// Collector resistance in killo ohms
Re=0.68;// Collector resistance in killo ohms
Ib=0.02;// Base Current in mA
Vce=7.3;// Collector to emitter voltage in volts
Vbe=0;// Base to emitter voltage in volts
Ve=2.1;// Emitter Voltage
Ie= Ve/Re;// Emiiter Current in mA
Ic=Ie;
Beta=Ic/Ib;//Common emitter D.C. Current gain
Vcc= Vce+Ic*(Rc+Re);//Supply Voltage
Rb=(Vcc-Ve)/Ib;//Base resistance in Killo ohms
disp(Beta,"Common emitter D.C. Current gain (
   unitless)")
disp(Vcc,"Supply Voltage in Volts")
disp(Rb,"base resistance in killo ohms")
```

Scilab code Exa 2.33 change in emitter to collector voltage

```
// Example 2.33:Ic & Vce
clc;
clear;
close;
Vcc=18;// Colector voltage in volts
Rc=2.2;// Collector resistance in killo ohms
Rb=510;// Base resistance in killo ohms
Re=1.8;// Emitter resistance in killo ohms
Beta=90;//Common emitter D.C. Current gain
Ib=Vcc/(Rb+Beta*(Rc+Re));// Base Current in mA
Ic=Beta*Ib;// Collector current in mA
Beta=Ic/Ib;//Common emitter D.C. Current gain
Vce= Ib*Rb;//Collector to emitter voltage in volts
disp(Vce,"Colector to emitter voltage In Volts")
disp (Ic,"Collector current in milli Ampere")
```

Scilab code Exa 2.34 base current

```
// Example 2.33:Ib
clc;
clear;
close;
Ie=10;//Emitter current in mA
Ic=9.95;//Collector current in mA
Ib=Ie-Ic;// Base Current in mA
disp(Ib,"Base Current in mA")
```

Scilab code Exa 2.35 base current collector current and collector to emitter voltage

```
// Example 2.35: Ic,Vc,Ve & Vce
```

```
clc;
clear;
close;
Vcc=30;// Colector voltage in volts
Beta=100;
Rc=6.2;// Collector resistance in killo ohms
Re=1.5;// Emitter resistance in killo ohms
Rb=690;// Base resistance in killo ohms
Vbe=0.7;// Base to emitter voltage in volts
Ib= (Vcc-Vbe)/(Rb+(1+Beta)*Rc+(1+Beta)*Re);
Ic=Ib*Beta;//in milli ampere
Ie=Ib*(1+Beta);//in milli ampere
Ve=Ie*Re;
Vce=Vcc-Ve-(Ic+Ib)*Rc;
Vc=Vce+Ve;
disp (Ic,"Collector current in milli Ampere")
disp(Vc,"collector voltage In Volts")
disp(Ve,"emitter voltage In Volts")
disp(Vce,"Colector to emitter voltage In Volts")
```

Scilab code Exa 2.36 resistance and stability factor

```
// Example 2.36:R1,Rc & S
clc;
clear;
close;
Vcc=16;// Colector voltage in volts
alfa=0.985;
Ieq=2;// Emiier current in mA
R2=30;// resistance in killo ohms
Re=1;// Emitter resistance in killo ohms
Vbe=0.2;// Base to emitter voltage in volts
Vceq=6;// Collector to emitter voltage in volts
Beta= alfa/(1-alfa);
Icq=alfa*Ieq;
```

```
Rc=(Vcc-Vceq-Ieq*Re)/Icq;
Ir1=((Ieq*Re+Vbe)/R2)+Icq/Beta;
R1=(Vcc-Vbe-(Ieq*Re))/Ir1;
Rb= (R1*R2)/(R1+R2);
S=(1+Beta)/(1+Beta*(Re/(Re+Rb)));
disp (R1," resistance in killo ohms")
disp(Rc,"Collector resistence in killo ohms")
disp (S,"The Stability factor")
```

Scilab code Exa 2.37.a Biasing components

```
// Example 2.37.a:baising component
clc;
clear;
close;
Vcc=12;// Colector voltage in volts
Beta=180;
Ieq=2;// Emiier current in mA
Rc=1;// Collector resistance in killo ohms
Vbe=0.6;// Base to emitter voltage in volts
Vceq=6;// Collector to emitter voltage in volts
Ic= (Vcc-Vceq)/Rc;
Ib=Ic/Beta;
Rb=(Vcc-Vbe)/Ib;
disp (Ic," Collector current in fixed bias case in mA")
disp(Ib,"Base current in fixed bias case in mA")
disp (Rb,"Base resistance in fixed bias case in killo ohms")
```

Scilab code Exa 2.37.b biasing components

```
// Example 2.37.b:baising component
```

```
clc;
clear;
close;
Vb=1.6;//
Ve=1;//
Vcc=12;// Colector voltage in volts
Beta=180;
Ieq=2;// Emiier current in mA
Rc=1;// Collector resistance in killo ohms
Vbe=0.6;// Base to emitter voltage in volts
Vceq=6;// Collector to emitter voltage in volts
Ic= (Vcc-Vceq-Ve)/Rc;
Ib=Ic/Beta;
Ie=Ic+Ib*10^-3;//emitter current in milli ampere
Re= (Ve/Ie);//emitter resistance in killo ohms
Ir2= 10*Ib;
R2= (Ve+Vbe)/Ir2;//
Ir1=Ir2+Ib;//
R1=((Vcc-Vb)/Ir1);//
disp (R2," RESISTANCE IN KILLO OHMS")
```

Scilab code Exa 2.38.a stability factor

```
// Example 2.38.a:S
clc;
clear;
close;
Beta=180;//Common emitter D.C. Current gain
Re=1;// Collector resistance in killo ohms
R1=5.76;// resistance in killo ohms
R2=34.67;// resistance in killo ohms
S=1+Beta;
disp(S,"Stability factor in fixed bias case is")
```

Scilab code Exa 2.38.b stability factor

```
// Example 2.38.b:S
clc;
clear;
close;
Beta=180;//Common emitter D.C. Current gain
Re=0.199;// Collector resistance in killo ohms
R1=5.76;// resistance in killo ohms
R2=34.67;// resistance in killo ohms
Rb=(R1*R2)/(R1+R2);
S=(1+Beta)/(1+Beta*(Re/(Re+Rb)));
disp(S,"Stability factor in self bias case is")
```

Scilab code Exa 2.39.a change in collector current

```
// Example 2.39.a: Stability factor
clc;
clear;
close;
R1=500;//Resistance in killo ohms
Rc=500;//Collector resistance in killo ohms
R2=5000;//Resistance in killo ohms
Vcc=20;// Colector voltage in volts
Beta=75;
Rc=6.2;// Collector resistance in killo ohms
Re=90;// Emitter resistance in ohms
Rb=690;// Base resistance in killo ohms
Vbe=0.7;// Base to emitter voltage in volts
Rb=((R1*R2)/(R1+R2));
Vb=Vcc * (R1/(R1+R2)); // vOLTAGE AT BASE
Icbo=0.02;// Collector to base leakage current in mA
```

```
Sre= (Re/(Rb+Re*Beta)^2)*(Icbo*10^-6*Rb-Beta(Vb+Rb*Icbo*10^-6-Vbe));
disp(Sre," Stability factor in A/ohms is")
```

Scilab code Exa 2.39.b change in collector current

```
// Example 2.39.b: Change in Icq
clc;
clear;
close;
R1=500;//Resistance in killo ohms
Rc=500;//Collector resistance in killo ohms
R2=5000;//Resistance in killo ohms
Vcc=20;// Colector voltage in volts
Beta=75;
Rc=6.2;// Collector resistance in killo ohms
Re=90;// Emitter resistance in ohms
Vbe=0.7;// Base to emitter voltage in volts
Rb=((R1*R2)/(R1+R2));
Vb=Vcc * (R1/(R1+R2)); // vOLTAGE AT BASE
Icbo=0.02;// Collector to base leakage current in mA
Sre= (Re/(Rb+Re*Beta)^2)*(Icbo*10^-6*Rb-Beta(Vb+Rb*Icbo*10^-6-Vbe));
DeltaRe= 110-90;// Change in  ohms
DeltaIcq= Sre*DeltaRe ;// Change in Icq
disp(DeltaIcq," Change in Icq in amperes")
```

Scilab code Exa 2.40 resistance

```
// Example 2.39.b: R1 & R2
clc;
clear;
close;
```

```
Vcc=5;// Colector voltage in volts
Beta=100;
Vce=2.5;// Collector to emitter voltage in volts
Vbe=0.6;// Base to emitter voltage in volts
R4=0.3;// Resistance in killo ohms
R2=10;// Resistance in killo ohms
Ic=1;// Collector current in mA
Vr4=(1+(1/Beta))*Ic*R4;
Vcn= Vce-Vr4;
R3=(Vcc-Vcn)/Ic;
Rb=8.03;// Base resistance in killo ohms
R1=(Rb*R2)/(R2-Rb);
disp(R1,"Resistance in killo ohms")
disp(Rb,"Base Resistance in killo ohms")
```

Scilab code Exa 2.41 resistance and stability factor

```
// Example 2.39.b: Re , S
clc;
clear;
close;
Vcc=12;// Colector voltage in volts
Beta=50;
Vce=2.5;// Collector to emitter voltage in volts
Vbe=0.7;// Base to emitter voltage in volts
Re= 2.57;// Emitter resistance in killo ohms
Rc=4.2;// Collector resistance in killo ohms
Ic=14/(Rc+(1+(1/Beta)*Re));
Ib= (6-Vbe-Ic*Re)/Re;
DeltaIb= -1;// Change in base Current
S= (1+Beta)/(1+Beta);
disp(Re,"Resistance in killo ohms")
disp(S,"Stability Fcator is")
```

Scilab code Exa 2.42 quiescent current

```
// Example 2.42: Icq
clc;
clear;
close;
T2=20;// Temperature in degree celsius
T1=0;// Temperature in degree celsius
Vcc=15;// Colector voltage in volts
Beta=75;
Vce=2.5;// Collector to emitter voltage in volts
Vbe1=0.7;// Base to emitter voltage in volts
Rb= 50;// Emitter resistance in killo ohms
Rc=3;// Collector resistance in killo ohms
Re=1;// Collector resistance in killo ohms
Ib= ((6-Vbe1)/(Rb+(1+Beta)*Re))*10^3;//Base Current
    in Micro Amperes
Ic= Beta*Ib*10^-3;// Colectore Current in  Milli
    Ampere
Icbo1=0.5;// Collector to base leakage current in
    Micrometer
Icbo2=Icbo1*2^((T2-T1)/10);// Collector to base
    leakage current in Micrometer when temperature 20
     degree celsius
Vbe2=Vbe1-2*T2*10^-3;// base to emitter voltage when
     temperature is 20 degree celsius
Ib1=((6-Vbe2)/(Rb+(1+Beta)*Re))*10^3;//Base Current
    in Micro Amperes at  20 degree celsius
Ic1=Beta*Ib*10^-3;// Colectore Current in  Milli
    Ampere
disp(Ib,"Base Current in micro amperes")
disp(Ic,"Collector current in mA")
disp(Icbo2,"Collector to base leakage current when T
    =20 degree celsius in micro ampere")
```

```
disp(Vbe2,"Base to emitter voltage when T==20 degree
    celsius in VOLTS ")
disp(Ib1,"Base Current when T=20 degree celsius in
   micro amperes")
disp(Ic1,"Collector current when T=20 degree celsius
    in mA")
```

Scilab code Exa 2.43 quiescent currents

```
// Example 2.43:(a)quiescent current (b) drift in
   quiescent current
clc;
clear;
close;
Beta1=50;//gain at 25 degree celsius temperture
Beta2=200;//gain at 75 degree celsius temperture
Rb=1;//base resistance in killo ohms
Re=0.1;//emitter resistance in  ohms
Ico1=0.01;//leakage current at 25 degree celsius
   temperture in micro ampere
Ico2=0.045;//leakage current at 75 degree celsius
   temperture in micro ampere
Vbe1=0.7;//base to emitter voltage  25 degree
   celsius temperture in micro ampere
Vbe2=0.575;//base to emitter voltage  75 degree
   celsius temperture in micro ampere
dBeta=Beta2-Beta1;//Change in gain
dIco=Ico2-Ico1;//change in leakage current
dVbe=Vbe2-Vbe1;//change in base to emitter voltage
Ib= (1-Vbe1)/(Rb+(1+Beta1)*Re);//Base current in
   micro ampere
Ic=Beta1*Ib;//Collector current in milli ampere
S=((1+Beta1)*(1+(Rb/Re)))/(1+Beta1+(Rb/Re));//
   stability factor
S1=-(Beta1/Re*10^-3)/(1+Beta1+(Rb/Re));//stability
```

```
factor
S2=(S*Ic*10^-3)/(Beta1*(1+Beta1));//stability factor
dIc= ((S*dIco*10^-6)+(S1*dVbe)+(S2*dBeta))*10^3;//
   change in collector current
Icn= Ic+dIc;//new collector current in milli ampere
disp(Ic,"quiescent current  in milli ampere is")
disp(dIc,"quiescent current drift at temperature 75
   degree celsius is in milli ampere")
disp(Icn,"new quiescent current  in milli ampere is"
   )
```

Scilab code Exa 2.44.a resistance

```
// Example 2.44.a:R1,R2  ,Re
clc;
clear;
close;
Vbe=0.2;//
Vcc=16;//collector voltage in volts
Rc=1.5;//clollector resistance in killo ohms
S=12;//stability factor
Vce=8;// Collector to emitter voltage
Ic=4; //in milli amperes
Beta=50;//gain
Ib=(Ic*10^-3)/Beta;// Base current in micro ampere
Re=(Vcc-Vce-(Rc*10^3*Ic*10^-3))/(Ic*10^-3+Ib);//
   emitter resistance in ohms
Rb=((11*(1+Beta))/(Beta-11))*Re*10^-3;//base
   resistance in killo ohms
Vr2= Vbe+(Ic+Ib*10^3)*Re*10^-3;//voltage is R2
x=(Vr2/Vcc);//Voltage
R1=(Rb)/x;//resistance in killo ohms
R2=(x*R1)/(1-x);//RESISTANCE IN KILLO OHMS
S1=3;//REDUCED STABILITY FACTOR
Rb1=((3*(1+Beta))/(Beta-3))*Re*10^-3;//EFFECT OF
```

```
   REDUCING STABILITY FACTOR ON BASE RESISTANCE
disp(Re*10^-3,"emitter resistance in killo ohms")
disp(R1,"resistance in killo ohms")
disp(R2,"resistance in killo ohms")
```

Scilab code Exa 2.44.b resistance

```
// Example 2.44.a:R1,R2  ,Re
clc;
clear;
close;
Vbe=0.2;//
Vcc=16;//collector voltage in volts
Rc=1.5;//clollector resistance in killo ohms
S=12;//stability factor
Vce=8;// Collector to emitter voltage
Ic=4; //in milli amperes
Beta=50;//gain
Ib=(Ic*10^-3)/Beta;// Base current in micro ampere
Re=(Vcc-Vce-(Rc*10^3*Ic*10^-3))/(Ic*10^-3+Ib);//
   emitter resistance in ohms
Rb=((2*(1+Beta))/(Beta-2))*Re*10^-3;//base
   resistance in killo ohms
Vr2= Vbe+(Ic+Ib*10^3)*Re*10^-3;//voltage is R2
x=(Vr2/Vcc);//Voltage
R1=(Rb)/x;//resistance in killo ohms
R2=(x*R1)/(1-x);//RESISTANCE IN KILLO OHMS
S1=3;//REDUCED STABILITY FACTOR
Rb1=((3*(1+Beta))/(Beta-3))*Re*10^-3;//EFFECT OF
   REDUCING STABILITY FACTOR ON BASE RESISTANCE
disp(Re*10^-3,"emitter resistance in killo ohms")
disp(R1,"resistance in killo ohms")
disp(R2,"resistance in killo ohms")
```

Scilab code Exa 2.45 resistance

```
// Example 2.45:R1,R2  ,Re
clc;
clear;
close;
Vbe=0.2;//
Vcc=20;//collector voltage in volts
Rc=2;//clollector resistance in killo ohms
S=10;//stability factor
Vce=10;// Collector to emitter voltage
Ic=4; //in milli amperes
Beta=50;//gain
Ib=(Ic*10^-3)/Beta;// Base current in micro ampere
Re=(Vcc-Vce-(Rc*10^3*Ic*10^-3))/(Ic*10^-3+Ib);//
   emitter resistance in ohms
Rb=((9*(1+Beta))/(Beta-9))*Re*10^-3;//base
   resistance in killo ohms
Vr2= Vbe+(Ic+Ib*10^3)*Re*10^-3;//voltage is R2
x=(Vr2/Vcc);//Voltage
R1=(Rb)/x;//resistance in killo ohms
R2=(x*R1)/(1-x);//RESISTANCE IN KILLO OHMS
S1=3;//REDUCED STABILITY FACTOR
Rb1=((3*(1+Beta))/(Beta-3))*Re*10^-3;//EFFECT OF
   REDUCING STABILITY FACTOR ON BASE RESISTANCE
disp(Re,"emitter resistance in ohms")
disp(R1,"resistance in killo ohms")
disp(R2,"resistance in killo ohms")
disp(Rb1,"base resistance in killo ohms effect of
   reducing stability factor reduces input impedence
   ")
```

Scilab code Exa 2.46 resistance

```
// Example 2.46:R1,R2  ,Re
clc;
clear;
close;
S=2;//stability factor
Vbe=0.8;//
Vcc=20;//collector voltage in volts
Rc=5;//clollector resistance in killo ohms
Vce=11.5;// Collector to emitter voltage
Ic=1.5; //in milli amperes
Beta=50;//gain
Ib=(Ic*10^-3)/Beta;// Base current in micro ampere
Re=(Vcc-Vce-(Rc*10^3*Ic*10^-3))/(Ic*10^-3+Ib);//
    emitter resistance in ohms
Rb=(((1+Beta))/(Beta-1))*Re;//base resistance in
    killo ohms
Vr2= Vbe+(Ic+Ib*10^3)*Re*10^-3;//voltage is R2
x=(Vr2/Vcc);//Voltage
R1=((Rb)/x)*10^-3;//resistance in killo ohms
R2=((x*R1)/(1-x))*10^3;//RESISTANCE IN KILLO OHMS
disp(Re,"emitter resistance in ohms")
disp(R1,"resistance in killo ohms")
disp(R2,"resistance in killo ohms")
```

Scilab code Exa 2.47 current gain input resistance and voltage gain

```
// Example 2.47:Ai,Ri,Av
clc;
clear;
close;
Rs=800;//Internal resistance in ohms
Rl=1000;//Load resistance in ohms
//H Paramters are
```

```
Hie=1;//in killo ohms
Hre=2*10^-4;
Hfe=50;
Hoe=25*10^-6;// in ampere per volt
Ai= -Hfe/(1+Hoe*Rl);// Current gain
Ri= Hie*10^3-((Hfe*Hre)/(Hoe+(1/Rl)));// Input
    resistance in ohms
Av= Ai*(Rl/Ri);// Voltage Gain
disp(Ai,"Current gain is")
disp(Ri,"Input resistance in ohms is")
disp(Av,"Voltage gain is")
```

Scilab code Exa 2.48 current gain input resistance and voltage gain

```
// Example 2.48:Ai,Ri,Av,Ro
clc;
clear;
close;
Rl=1.2*10^3;//Load resistance in ohms
//H Paramters are
Hib=28;//in  ohms
Hrb=5*10^-4;
Hfb=-0.98;
Hob=0.34*10^-6;// in ampere per volt
Ai= -Hfb/(1+Hob*Rl);// Current gain
Ri= Hib+(Hrb*Ai*Rl);// Input resistance in ohms
Av= round(Ai*(Rl/Ri));// Voltage Gain
dh=(Hib*Hob)-(Hrb*Hfb);
Ro=(Hib/dh)*10^-3;// Output resistance in killo ohms
disp(Ai,"Current gain is")
disp(Ri,"Input resistance in ohms is")
disp(Av,"Voltage gain is")
disp(Ro,"Ouput resistance in killo ohms")
```

Scilab code Exa 2.49 current gain input resistance and voltage gain

```
// Example 2.49:Ai,Ri,Av,Avs,Ais
clc;
clear;
close;
Rl=1000;//Load resistance in ohms
Rs=1200;// Internal Resistance
//H Paramters are
Hib=22;//in  ohms
Hrb=3*10^-4;
Hfb=-0.98;
Hob=0.5*10^-6;// in ampere per volt
Ai= -Hfb/(1+Hob*Rl);// Current gain
Ri= Hib+(Hrb*Ai*Rl);// Input resistance in ohms
Av=(Ai*(Rl/Ri));// Voltage Gain
dh=(Hib*Hob)-(Hrb*Hfb);
Avs=(Av*Ri)/(Ri+Rs);// Overall Voltage gain
Ais=(Ai*Rs)/(Ri+Rs);// Overall Current gain
disp(Ai,"Current gain is")
disp(Ri,"Input resistance in ohms is")
disp(Av,"Voltage gain is")
disp(Ais,"Overall Current gain is")
disp(Avs,"Overall Voltage gain is")
```

Scilab code Exa 2.50 current gain input resistance voltage gain and output resistance

```
// Example 2.50:Ai,Ri,Av,Ro
clc;
clear;
close;
```

```
R1=5000;//Load resistance in ohms
Rs=1000;//Source internal resistance
R1=10;//Resistance in killo ohms
R2=10;//Resistance in killo ohms
Re=5*10^3;//Emitter resistance in  ohms
//H Paramters are
Hic=2;//in killo ohms
Hrc=1;
Hfc=-51;;
Hoc=25*10^-6;// in ampere per volt
Ai= -Hfc/(1+Hoc*Rl);// Current gain
Ri= (Hic+(Hrc*Ai*Rl))*10^-3;// Input resistance in
    killo ohms
Z1= (R1*R2)/(R1+R2);//
Zi=(Ri*Z1)/(Ri+Z1);// input resistance of amplifier
    stage in killo ohms
Av=round((Ai*(Rl/Ri))*10^-3)// Voltage Gain
Ro=-(Rs+Hic*10^3)/Hfc;// Output resistance in  ohms
Zo= (Ro*Re)/(Ro+Re);//output resistance of amplifier
     stage in ohms
disp(Ai,"Current gain is")
disp(Ri,"Input resistance in ohms is")
disp(Av,"Voltage gain is")
disp(Zi,"input resistance of amplifier stage in
    killo ohms")
disp(Ro,"Output resistance in  ohms")
disp(Zo,"output resistance of amplifier stage in
    ohms")
```

Scilab code Exa 2.51 current gain input resistance and voltage gain

```
// Example 2.51:Ai,Ri,Av,Z0
clc;
clear;
close;
```

```
R1=20;//Resistance in killo ohms
R2=10;//Resistance in killo ohms
Rc=5;//collector resistance in killo ohms
R=10;//resistance in killo ohms
Rs=800;//Internal resistance in ohms
Rl=(Rc*R)/(Rc+R);//Load resistance in killo ohms
//H Paramters are
Hie=1.5;//in killo ohms
Hre=5*10^-3;
Hfe=50;
Hoe=2*10^-6;// in micro ampere per volt
Ai= -Hfe;// Current gain
Ri= Hie;// Input resistance in ohms
Z1= (R1*R2)/(R1+R2);//
Zi=(Ri*Z1)/(Ri+Z1);// input resistance of amplifier
    stage in killo ohms
Av= round(Ai*(Rl/Ri));// Voltage Gain
Ro=(1/Hoe)*10^3;//output resistane in killo ohms
Zo=(Ro*Rl)/(Ro+Rl);//output resistance of amplifier
    stage in ohms
disp(Ai,"Current gain is")
disp(Zi,"input resistance of amplifier stage in
    killo ohms")
disp(Av,"Voltage gain is")
disp(Zo,"output resistance of amplifier stage in
    ohms")
```

Scilab code Exa 2.52 current gain input resistance and voltage gain

```
// Example 2.52:Ai,Ri,Av
clc;
clear;
close;
Rs=0.5;//Internal resistance in killo ohms
Rl=5;//Load resistance in killo ohms
```

```
//H Paramters are
Hie=1;//in killo ohms
Hfe=50;
Hoe=25*10^-6;// in ampere per volt
Ai= (1+Hfe)/(1+Hoe*Rl*10^3);// Current gain
Ri= Hie+(Ai*Rl);// Input resistance in killo ohms
Av= Ai*(Rl/Ri);// Voltage Gain
disp(Ai,"Current gain is")
disp(Ri,"Input resistance in killo ohms is")
disp(Av,"Voltage gain is")
```

Scilab code Exa 2.53 current gain input resistance voltage gain and power gain

```
// Example 2.53:Ai,Ri,Av
clc;
clear;
close;
Rs=1;//Internal resistance in  ohms
Rl=1600;//Load resistance in ohms
//H Paramters are
Hie=1100;//in  ohms
Hfe=2.5*10^-4;
Hoe=25*10^-6;// in ampere per volt
Ai= -Hfe/(1+Hoe*Rl);// Current gain
Ri= round(Hie+(Ai*Rl));// Input resistance in ohms
Av= Ai*(Rl/Ri);// Voltage Gain
Pg=Ai*Av;//
disp(Ai,"Current gain is")
disp(Ri,"Input resistance in killo ohms is")
disp(Av,"Voltage gain is")
disp(Pg,"Power gain is")
```

Scilab code Exa 2.54.a quiescent point

```
// Example 2.54.a:Icq,Vcq
clc;
clear;
close;
Vbe=0;//
Vcc=18;//collector voltage in volts
R1=510;//resistance in killo ohms
R2=510;//resistance in killo ohms
Rc=9.1;//clollector resistance in killo ohms
Re=7.5;//emitter resistance in killo ohms
Rs=1;//Internal resistance in  ohms
Rl=1600;//Load resistance in ohms
Vb=Vcc * (R2/(R1+R2)); // vOLTAGE AT BASE
Ic= (Vb-Vbe)/Re; //in milli amperes
Vce= Vcc-(Ic*(Rc+Re)); //Colector to emitter voltage
    in volts
//H Paramters are
Hie=1100;//in  ohms
Hfe=2.5*10^-4;
Hoe=25*10^-6;// in ampere per volt
Ai= -Hfe/(1+Hoe*Rl);// Current gain
Ri= round(Hie+(Ai*Rl));// Input resistance in ohms
Av= Ai*(Rl/Ri);// Voltage Gain
disp(Vce,"Colector to emitter voltage In Volts")
disp (Ic,"Collector current in milli Ampere")
```

Scilab code Exa 2.54.b voltage gain and input resistance

```
// Example 2.54.b:Av,Ri
clc;
clear;
close;
Vbe=0;//
```

```
Vcc=18;//collector voltage in volts
R1=510;//resistance in killo ohms
R2=510;//resistance in killo ohms
Rc=9.1;//clollector resistance in killo ohms
Re=7.5;//emitter resistance in killo ohms
Rs=1;//Internal resistance in  ohms
Rl=1600;//Load resistance in ohms
Vb=Vcc * (R2/(R1+R2)); // vOLTAGE AT BASE
Ic= (Vb-Vbe)/Re; //in milli amperes
Vce= Vcc-(Ic*(Rc+Re)); //Colector to emitter voltage
    in volts
//H Paramters are
Hie=1;//in  killo ohms
Hfe=50;
Hoe=0;// in ampere per volt
Ai=-Hfe;//current gain
Ri=Hie;// Input resistance in ohms
Z1= (R1*R2)/(R1+R2);//
Zi=(Ri*Z1)/(Ri+Z1);// input resistance of amplifier
    stage in killo ohms
Av= Ai*(Rc/Ri);// Voltage Gain
disp(Zi,"input resistance of amplifier stage in
    killo ohms")
disp(Av,"Voltage gain is")
```

Scilab code Exa 2.55 resistive parameters

```
// Example 2.55:ressitive paramters
clc;
clear;
close;
Ic= 5; //in milli amperes
Vt=26;//volatge
//H Paramters are
hie=1;//in killo ohms
```

```
hfe=100;
hoe=4*10^-5;// in ampere per volt
hre=10^-4;
gm=Ic/Vt;//transconductance
rbe= hfe/gm;// in ohms
rbb=hie*10^3-rbe;//in ohms
rbc=(rbe/(hre)*10^-6);//in mega ohms
gce1=hoe-(1+hfe)*(1/(rbc*10^6));//in mho
rce=(1/gce1)*10^-3;//in killo ohms
disp(gm,"transconductance")
disp(rbe,"in ohms")
disp(rbc,"in mega ohms")
disp(rbb,"in ohms")
disp(gce1,"in mho")
disp(rce,"in killo ohms")
```

Scilab code Exa 2.56 resistive parameters

```
// Example 2.56:ressitive paramters
clc;
clear;
close;
Ic= 1; //in milli amperes
Vt=26;//volatge
ft=80;//frequency in mega hertz
Cbc=12;//in pico farad
//H Paramters are
hie=6;//in killo ohms
hfe=224;
gm=Ic/Vt;//transconductance
rbe= hfe/gm;// in ohms
rbb=hie*10^3-rbe;//in ohms
Cbe= (((gm)/(2*%pi*ft*10^6))-Cbc*10^-12)*10^12;//in
    pico farad
disp(gm,"transconductance")
```

```
disp(rbe,"in ohms")
disp(rbb,"in ohms")
disp(Cbe,"in pico farad")
```

Scilab code Exa 2.57 cut off frequencies

```
// Example 2.57:alpha ,beta and cut off frequencies
clc;
clear;
close;
Cbc=12;//in pico farad
//H Paramters are
hie=6;//in killo ohms
hfe=224;
gm=38;//transconductance
rbe=5.9;// in killo ohms
rbb=100;//in ohms
Cbe= 63;//in pico farad
falpha= ((hfe)/(2*%pi*rbe*10^3*Cbe*10^-12))*10^-6;//
fbeta= ((1)/(2*%pi*rbe*10^3*(Cbe+Cbc)*10^-12))
    *10^-6;//
ft= ((gm*10^-3/(2*%pi*(Cbe+Cbc)*10^-12)))*10^-6;//
disp(falpha,"in mega hertz")
disp(fbeta,"in mega hertz")
disp(ft,"in mega hertz")
```

Scilab code Exa 2.58 resistive parameters

```
// Example 2.58:ressitive paramters
clc;
clear;
close;
Ic= 2.6; //in milli amperes
```

```
Vt=26;//volatge
ft=500;//frequency in mega hertz
Cbc=3;//in pico farad
rbb=100; //in ohms
rbe=1;//IN KILLO OHMS
gm=Ic/Vt;//transconductance
Beta= gm*rbe*10^3;//
Cbe= (((gm)/(2*%pi*ft*10^6))-Cbc*10^-12)*10^12;//in
   pico farad
disp(gm,"transconductance")
disp(Cbe,"in pico farad")
```

Scilab code Exa 2.59 h parameters and hybrid parameters

```
// Example 2.59:h parameters and hybrid parameters
clc;
clear;
//H Paramters are
hie=1100;//in killo ohms
hre=2*10^-4;
hfe=50;
hoe=2.5*10^-5;// in ampere per volt
hic=hie;//
hrc=1-hre;//
hfc=-(1+hfe);//
hoc=hoe;//
hib=(hie/(1+hfe));//
hrb= ((hie*hoe)/(1+hfe))-hre;//
hob=(hoe/(1+hfe));//
rbb=100;
rbe=(hie-rbb)*10^-3;//in killo ohms
rbc= ((hie-rbb)/hre)*10^-6;//
gm= ((hfe/(hie-rbb)));//
x=hoe-((hfe*hre)/(hie-rbb));//
rce=1/(1.25*10^-2);//
```

```
disp(hic,"hic=",hrc,"hrc=",hfc,"hfc=",hoc,"hoc=","H-parameters for common collector configuration are")
disp(hib,"hib=",hrb,"hrb=",hob,"hob=","H-parameters for common collector configuration are")
disp(rbe,"rbe(in killo ohms)=",rbc,"rbc(mega ohms)=",gm,"transconductance(mho)=",rce,"rce(in killo ohms)=","hybrid pie paramtere are")
```

Scilab code Exa 2.60 hybrid model parameters

```
// Example 2.60:hybrid parameters
clc;
clear;
Ic= 10; //in milli amperes
Vt=26;//volatge
ft=500;//frequency in mega hertz
Cbc=3;//in pico farad
gm=Ic/Vt;//transconductance
//H Paramters are
hie=500;//in killo ohms
hfe=100;
hre=0.1;//
hoe=4*10^-5;// in ampere per volt
rbe=hfe/gm;// in ohms
rbc= ((rbe)/hre)*10^-3;//
x=hoe-((hfe*10^-4)/(rbe));//
rce=(1/(x*10^-2))*10^-5;//
Cbe=(((gm)/(2*%pi*ft*10^6))*10^13-Cbc);//in pico farad
disp(gm,"(gm)transconductance")
disp(rbe,"(rbe)in ohms")
disp(rbc,"(rbc)in mega ohms")
disp(rce,"(rce)in killo ohms")
disp(Cbe,"(Cbe)in pico farad")
```

Scilab code Exa 2.61 hybrid parameters

```
// Example 2.61:hybrid parameters
clc;
clear;
Ai=10;//current gain
Vce=10;//
Ic= 10; //in milli amperes
Vt=26;//volatge
f=10//frequency in mega hertz
Cbc=3;//in pico farad
gm=Ic/Vt;//transconductance
//H Paramters are
hie=500;//in ohms
hfe=100;
rbe= hfe/gm;//
rbb= hie-rbe;//
Ft= Ai*f;//in mega hertz
fb= Ft/hfe;//
Ce=((gm/(2*%pi*Ft*10^6))-Cbc*10^-12)*10^12;//
disp(gm*10^3,"(gm) in mS")
disp(rbe,"(rbe)in ohms")
disp(rbb,"(rbb) in ohms")
disp(Ft,"(ft) in mega hertz")
disp(fb,"(fb) in mega hertz")
disp(Ce,"(Ce)in picofarad")
```

Scilab code Exa 2.62 mid band voltage gain and upper 3 db cut off frequency

```
// Example 2.62:mid band voltage gain and cut off
   frequency
```

```
clc;
clear;
Rs=1;//
ft=500//frequency in mega hertz
Cbc=5;//in pico farad
//H Paramters are
hie=500;//in ohms
hfe=100;
rbe= 900;////
rbb= 100;//
Rl=500;//load resistance in ohms
gm=hfe/rbe;//in mho
Av=((-gm*Rl));//voltage gain
Avs= ((Av*rbe)/(Rs*10^3+rbb+rbe));//mid band voltage
    gain
fb= ft/hfe;//
disp(Avs,"(Avs)mid band voltage gain is")
disp(fb,"(fb) in mega hertz")
```

Scilab code Exa 2.63 mid band voltage gain and upper 3 db cut off frequency

```
// Example 2.63:mid band voltage gain and cut off
    frequency
clc;
clear;
Rs=1;//
ft=500//frequency in mega hertz
Cbc=5;//in pico farad
//H Paramters are
gm=100;//in mho
hfe=100;//
rbe=hfe/(gm*10^-3);// in ohms
rbb= 100;//
Rl=500;//load resistance in ohms
```

```
Av=((-gm*10^-3*Rl));//voltage gain
Avs= ((Av*rbe)/(Rs*10^3+rbb+rbe));//mid band voltage
    gain
fb= ft/hfe;//
disp(Avs,"(Avs)mid band voltage gain is")
disp(fb,"(fb) in mega hertz")
```

Scilab code Exa 2.64 resonant frequency and voltage drop

```
// Example 2.64:resonant frequency and voltage drop
clc;
clear;
L=100;//in micro henry
C=253.3;//in micro farad
R=15.7;//in ohms
fr=((1/(2*%pi*sqrt(L*10^-6*C*10^-12))))*10^-6;//
    resonant frequency in mega hertz
V=0.157;//
Ir=V/R;//
Vr=V;//
Vl=Ir*(2*%pi*fr*10^6*L*10^-6);//
Xc= (1/(2*%pi*fr*10^6*C*10^-12));//
Vc= Ir*Xc;//
Q=((2*%pi*fr*10^6*L*10^-6)/R);
disp(fr,"resonant frequency in mega hertz")
disp(Vr,"Voltage drop across ressitance")
disp(Vl,"Voltage drop across inductor")
disp(Vc,"Voltage drop across capacitor")
disp(Q,"Quality factor of coil is")
```

Scilab code Exa 2.65 resonant frequency impedence q factor bandwidth and line current

```
// Example 2.65:resonant frequency ,impedence ,Q-
   factor ,Bnadwidth ,line current and resonant
   frequency
clc;
clear;
V=10;//
L=1.2;//in micro henry
C=200;//in micro farad
R=8;//in ohms
fr=(1/(2*%pi))*(sqrt((1/(L*10^-3*C*10^-12))-(R^2/(L
   *10^-3)^2))*10^-3);//resonant frequency in killo
   hertz
Zr=(L*10^-3)/(C*10^-9*R);//IN KILLO OHMS
Q=((2*%pi*fr*10^6*L*10^-6)/R);
BW=fr/Q;//
Ir=(V/Zr)*10^3;//
fr1=((1/(2*%pi*sqrt(L*10^-3*C*10^-12))))*10^-3;//
   resonant frequency in mega hertz
disp(fr,"resonant frequency in killo hertz")
disp(Zr,"Impedence in kilo ohms is")
disp(BW,"bandwidth in killo hertz is")
disp(Ir,"line current in milli ampere")
disp(Q,"Quality factor of coil is")
disp(fr1,"resonant frequency in killo hertz
   neglecting resistance")
```

Scilab code Exa 2.66 resonant frequecy impedence q factor and bandwidth

```
// Example 2.66:resonant frequency ,impedence ,Q-
   factor ,Bnadwidth
clc;
clear;
V=10;//
L=150;//in micro henry
```

```
C=100;//in micro farad
R=5;//in ohms
fr=((1/(2*%pi*sqrt(L*10^-6*C*10^-12))))*10^-3;//
    resonant frequency in killo hertz
Zr=(L*10^-3)/(C*10^-9*R);//IN KILLO OHMS
Q=((2*%pi*fr*10^6*L*10^-6)/R)*10^-3;
BW=(fr/Q);//
disp(fr,"resonant frequency in killo hertz")
disp(Zr*10^-3,"Impedence in kilo ohms is")
disp(BW,"bandwidth in killo hertz is")
disp(Q,"Quality factor of coil is")
```

Scilab code Exa 2.67 Q FACTOR

```
// Example 2.67:Q FACTOR
clc;
clear;
fr=1600;//resonant frequency in killo hertz
BW=10;//In kill hertz
Qr=fr/BW;
disp(Qr,"value of quality factor is")
```

Scilab code Exa 2.68 Q FACTOR

```
// Example 2.68:Q FACTOR
clc;
clear;
fr=2*10^6;//resonant frequency in hertz
BW=50*10^3;// hertz
Qr=fr/BW;
disp(Qr,"value of quality factor is")
```

Scilab code Exa 2.69 PARALLEL IMPEDENCE

```
// Example 2.69: parallel impedence
clc;
clear;
fr=445*10^3;//resonant frequency in hertz
BW=10*10^3;// hertz
Xl=1255;// inductive reactance in ohm
Qr=fr/BW;
R=Xl/Qr;
L=Xl/(2*%pi*fr);
C=1/(2*%pi*fr*Xl);
Zp=(L/(C*R))*10^-3;
disp(Qr,"value of quality factor is")
disp(R,"resisitance = (ohm)")
disp(L,"inductance = (H)")
disp(C,"capacitor= = (F)")
disp(Zp,"parallel impedence = (killo ohm)")
```

Chapter 3

TRANSISTOR AMPLIFIERS

Scilab code Exa 3.1 input impedence output impedence and current gain

```
// Example 3.1: calculate the input impedence,
   output impedence, voltage gain and current gain
clc, clear
Hie=500; // the h-parameters of the transistor in
   ohm
Hfe=60; // the h-parameters of the transistor in ohm
Ic=3*10^-3; // collector current in ampere
Rb=220*10^3; // resistance in ohm
Rc=5.1*10^3; // resistance in ohm
zi=Hie;
zo=Rc;
Av=-Hfe*Rc/Hie;
Ai=-Hfe
Vcc=12; // voltage in volts
Vbe=0.6; // voltage in volts
Beta=60; // for transistor
Ib=(Vcc-Vbe)/Rb;
Ie=Beta*Ib;
re=26*10^-3/Ie;
Zin=Beta*re;
Zout=Rc;
```

```
Av1=-Rc/re;
Ai1=-Beta;
disp("part 1 -from h-parameter model")
disp(zi,"input impedence (ohm) = ")
disp(zo,"ouput impedence (ohm) = ")
disp(Ai,"current gain (unitless) = ")
disp(Av,"voltage gain (unitless) = ")
disp("part 2 -from re model")
disp(Ib,"base curret (A) = ")
disp(Ie,"emitter curret (A) = ")
disp(re,"resistance = ")
disp(Zin,"input impedence (ohm) = ")
disp(Zout,"ouput impedence (ohm) = ")
disp(Ai1,"current gain (unitless) = ")
disp(Av1,"voltage gain (unitless) = ")
```

Scilab code Exa 3.2 input impedence output impedence and current gain

```
// Example 3.2: calculate the input impedence,
   output impedence, voltage gain and current gain
clc, clear;
Hie=3.2; // the h-parameters of the transistor in
   kilo-ohm
Hfe=100; // the h-parameters of the transistor
R1=40; // resistance in kilo-ohm
R2=4.7; // resistance in kilo-ohm;
Rc=4; // resistance in kilo-ohm;
Re=1.2; // resistance in kilo-ohm;
Rb=(R1*R2)/(R1+R2);
zi=(Rb*Hie)/(Rb+Hie);
zo=Rc;
Av=-(Hfe*Rc)/Hie;
Ai=-(Rb*Hfe)/(Rb+Hie);
Vcc=16; // voltage in volts
Vbe=0.6; // voltage in volts
```

```
Beta=100; // for transistor
Vb=(R2*Vcc)/(R1+R2);
Ib=(Vb-Vbe)/(Rb+(1+Beta)*Re);
Ic=Beta*Ib;
Ie=Ic;
re=26/Ie;
Zin=(Rb*(Beta*re*10^-3))/(Rb+(Beta*re*10^-3));
Zout=Rc;
Av1=-(Rc*10^3)/re;
Ai1=-(Beta*(Rb*10^3))/((Rb*10^3)+(Beta*re));
disp("part 1 -from h-parameter model")
disp(Rb,"base resistance (kilo-ohm) = ")
disp(zi,"input impedence (kilo-ohm) = ")
disp(zo,"ouput impedence (kilo-ohm) = ")
disp(Ai,"current gain (unitless) = ")
disp(Av,"voltage gain (unitless) = ")
disp("part 2 -from re model")
disp(Vb,"base voltage (V) = ")
disp(Ib,"base curret (mA) = ")
disp(Ic,"collector curret (mA) = ")
disp(Ie,"emitter curret (mA) = ")
disp(re,"resistance = ")
disp(Zin,"input impedence (kilo-ohm) = ")
disp(Zout,"ouput impedence (kilo-ohm) = ")
disp(Ai1,"current gain (unitless) = ")
disp(Av1,"voltage gain (unitless) = ")
```

Scilab code Exa 3.3 input impedence output impedence and current gain

```
// Example 3.3: calculate the input impedence, output impedence, voltage gain and current gain
clc, clear
Re=4; // resistance in kilo-ohm
Rc=3; // resistance in kilo-ohm
Vcc=10; // collector voltage in volts
```

```
Vee=8; // emitter voltage in volts
Vbe=0.6; // base voltage in volts
Ie=(Vee-Vbe)/(Re*10^3)
re=26*10^-3/Ie;
zi=((Re*10^3)*re)/((Re*10^3)+re);
zo=Rc;
Av=Rc/(re*10^-3);
Ai=Ie/Ie;
disp(Ie,"emitter current (A) = ")
disp(zi,"input impedence (ohm) = ")
disp(zo,"ouput impedence (kilo-ohm) = ")
disp(Ai,"current gain (unitless) = ")
disp(Av,"voltage gain (unitless) = ")
```

Scilab code Exa 3.4 collector efficiency

```
// Example 3.1: determine collector efficiency
clc, clear;
Vmax=25; //collector emitter voltag in volts
Vmin=2.5;//collector emitter voltag in volts
eta=(50*((Vmax-Vmin)/(Vmax+Vmin)));
disp(eta,"collector efficiency (%) = ")
```

Scilab code Exa 3.5 maximum power output

```
// Example 3.1: determine maximum output power
clc, clear;
Rl=80; // load resistance in ohm
alfa=5; // turn ratio
Ic=120; // collector current in milli-ampere
Rl1=alfa^2*Rl;
Imax=2*Ic;
Imin=0;
```

```
Irms=(1/sqrt(2))*((Imax-Imin)/2);
Pout=((Ic*10^-3)^2*Rl1)/2;
disp(Rl1,"load as seen by transformer primary (ohm)
   = ")
disp(Imax,"maximum current (mA) = ")
disp(Imin,"minimum current (mA) = ")
disp(Irms,"rms value of current (mA) = ")
disp(Pout,"maximum power output (W) = ")
```

Scilab code Exa 3.6 power rating of transistor

```
// Example 3.1: (i) maximum output power (ii)
   maximum collector efficiency (iii) power rating
   of the transistor
clc, clear;
Vcc=10; // collector supply voltage in volts
Icq=200; // zero-signal collector current in milli-
   ampere
Rl=2; // load resistance in ohm
alfa=5; // turn ratio
Pout=(Vcc*(Icq*10^-3))/2;
Pin=(Vcc*(Icq*10^-3));
eta=(Pout/Pin)*100;
P=(Vcc*(Icq*10^-3));
Rl1=(alfa^2)*Rl;
disp(Pout,"output power for dc (w) = ")
disp(Pin,"input power for ac (w) = ")
disp(eta,"collector efficiency (%) = ")
disp(P,"power rating of the transistor (w) = ")
disp(Rl1,"load by the tranformer primary (ohm) = ")
```

Scilab code Exa 3.7 power dissipated and efficiency

```
// Example 3.7: (i) Vce maximum (ii) Vce minimum (iii) Ic maximum (iv) Ic minimum (v) rms value of load current and voltage (vi) ac power developed across the load pated (vii) power dissi(viii) the efficiency of the amplifier circuit
clc, clear;
alpha=3;//
Podc=0.434;//output ac power in watts
Icq=140;//current in milli ampere
Rl=8;//load resistance in killo ohms
Vcq=10;
Vcc=Vcq;//
Vcemax=18.3;//maximum collector to emitter voltage in volts
Vcemin=2.5;//minimum collector to emitter voltage in volta
Icmax=245;//maximum collector current in mili ampere
Icmin=25;//minimum collector current in mili ampere
Vlrms=(Vcemax-Vcemin)/(2*sqrt(2));//
VLrms=(1/alpha)*Vlrms;//rms value of load voltage
ILrms=(VLrms/Rl)*10^3;//rms value of load current
Pindc=Vcc*Icq*10^-3;// ac power developed across the load in watts
Pd=Pindc-Podc;// power dissipated in watts
n=(Podc/Pindc)*100;//efficieny
disp(Vcemax,"maximum collector to emitter voltage in volts")
disp(Vcemin,"minimum collector to emitter voltage in volts")
disp(Icmax,"maximum collector current in mili ampere")
disp(Icmin,"minimum collector current in mili ampere")
disp(VLrms,"rms value of load voltage")
disp(ILrms,"rms value of load current in milli ampere")
disp(Pindc,"ac power developed across the load in watts")
```

```
disp(Pd,"power dissipated in watts")
disp(n,"efficiency in percentage is")
```

Scilab code Exa 3.8 overall efficiency

```
// Example 3.8: overall efficiency
clc, clear;
Vcc=20; // in volts
Vce=2.5; // in volts
eta=78.5*(1-(Vce/Vcc));
disp(eta,"the overall efficiency (%) = ")
```

Scilab code Exa 3.9.a harmonic distortion

```
// Example 3.9 (a): the percent second harmonic
    distortion
clc, clear;
V1ce=22; // maximum voltage in volts
V2ce=1.2; // minimum voltage in volts
Vceq=10; // in volts
D2=(((1/2)*(V1ce+V2ce)-Vceq)/(V1ce-V2ce))*100;
disp(D2," the percent harmonic distortion (%) = ")
```

Scilab code Exa 3.9.b harmonic distortion

```
// Example 3.9 (b): the percent second harmonic
    distortion
clc, clear;
V1ce=18; // maximum voltage in volts
V2ce=2; // minimum voltage in volts
```

```
Vceq=10; // in volts
D2=(((1/2)*(V1ce+V2ce)-Vceq)/(V1ce-V2ce))*100;
disp(D2," the percent harmonic distortion (%) = ")
```

Scilab code Exa 3.10 harmonic distortion and percentage

```
//Exa 3.10
clc;
clear;
close;
//given data :
//Vs=1.95*sin(400*t);in volt
//io=12*sin400*t+1.2*sin800*t+0.9*sin*1200*t+0.4*sin1600*t
//from current we have
V1=12;//in volt
V2=1.2;//in volt
V3=0.9;//in volt
V4=0.4;//in volt
//Harmonic distortion of each component is expressed as :
D2=V2/V1;//unitless
D3=V3/V1;//unitless
D4=V4/V1;//unitless
//Total distortion
D=sqrt(D2^2+D3^2+D4^2);//unitless
disp("Total disortion : "+string(D)+" or "+string(D*100)+"%");
//Total Power
disp("Total Power, P=(1+D2^2)*P1");
disp("Percentage Increase in power because of distortion=(P-P1)*100/P1");
PowerIncrease=D^2*100;//in %
disp(PowerIncrease,"Percentage Increase in power = ");
```

Scilab code Exa 3.11.a minimum power drain

```
// Example 3.11 (i): minimum power drain on the
   power supply
clc, clear;
Pl=10; // power delivered to load in watt
eta1=80/100; // output transformer efficiency
eta=78.5/100; // efficiency of a class B push pull
   amplfier under optimum condition
Pout=Pl/eta1;
Pin=Pout/eta;
disp(Pout,"ac power output of amplifier (W) = ")
disp(Pin,"minimum power drain on the power supply (W
   ) = ")
```

Scilab code Exa 3.11.b minimum average power dissipation

```
// Example 3.11 (ii): minimum average power
   dissipation
Pl=10; // power delivered to load in watt
eta1=80/100; // output transformer efficiency
eta=78.5/100; // efficiency of a class B push pull
   amplfier under optimum condition
Pout=Pl/eta1;
Pin=Pout/eta;
Pd=Pin-Pout;
Pd1=Pd/2;
disp(Pout,"ac power output of amplifier (W) = ")
disp(Pin,"minimum power drain on the power supply
   for dc (W) = ")
disp(Pd,"minimum average power dissipation (W) = ")
```

```
disp(Pd1," minimum average power dissipation rating
    required for each transistor (W) = ")
```

Scilab code Exa 3.12 power and conversion efficiency

```
// Example 3.12 : the percent second harmonic
    distortion
clc, clear;
Vcc=50; // voltage in volts
Vmin=5; // minimum voltage in volts
pi=3.142857;
Pd=40; // total power dissipation in watt
Icmax=Pd/(((2*Vcc)/pi)-((Vcc-Vmin)/2));
Pin=(2/pi)*(Vcc*Icmax);
Pout=((Icmax/2)*(Vcc-Vmin));
eta=(Pout/Pin)*100;
disp(Icmax,"maximum collector current (A) = ")
disp(Pin,"total power input (W) = ")
disp(Pout,"ac power output (W) = ")
disp(eta,"conversion efficiency (%) = ")
```

Chapter 4

FIELD EFFECT TRANSISTORS AND MOSFETs

Scilab code Exa 4.1 drain current

```
// Example 4.1: find the drain current
clc, clear
Idss=15; // maximum drain current in mili-ampere
VgsOFF=-5; // pinch off voltage in volts
Vgs1=0; // gate source voltage in volts
Vgs2=-1; // gate source voltage in volts
Vgs3=-4; // gate source voltage in volts
Id1=Idss*(1-(Vgs1/VgsOFF))^2;
Id2=Idss*(1-(Vgs2/VgsOFF))^2;
Id3=Idss*(1-(Vgs3/VgsOFF))^2;
disp(Id1,"drain current (mA) = ")
disp(Id2,"drain current (mA) = ")
disp(Id3,"drain current (mA) = ")
```

Scilab code Exa 4.2 drain current

```
// Example 4.2: find the drain current
clc, clear
Idss=12; // maximum drain current in mili-ampere
VgsOFF=-20; // pinch off voltage in volts
Vgs1=0; // gate source voltage in volts
Vgs2=-5; // gate source voltage in volts
Vgs3=-10; // gate source voltage in volts
Vgs4=-15; // gate source voltage in volts
Vgs5=-20; // gate source voltage in volts
Id1=Idss*(1-(Vgs1/VgsOFF))^2;
Id2=Idss*(1-(Vgs2/VgsOFF))^2;
Id3=Idss*(1-(Vgs3/VgsOFF))^2;
Id4=Idss*(1-(Vgs4/VgsOFF))^2;
Id5=Idss*(1-(Vgs5/VgsOFF))^2;
disp(Id1,"drain current (mA) = ")
disp(Id2,"drain current (mA) = ")
disp(Id3,"drain current (mA) = ")
disp(Id4,"drain current (mA) = ")
disp(Id5,"drain current (mA) = ")
```

Scilab code Exa 4.3 minimum and maximum transconductance curve

```

// Example 4.3: Plot the min and max
   transconductance curve
clc, clear
//given data
//VGS_off=-2 to -6 volt
//IDSS=8 to 20 mA
//Formula : ID=IDSS*[1-VGS/VGS_off]^2
//Let take some values for plotting
IDSS=8;//mA
VGS=0:-0.5:-2;//in Volt
```

```
VGS_off=-2 ;// in Volt
ID=zeros(1,5)
for i=1:5
    ID(i)=IDSS*[1-VGS(i)/VGS_off]^2
end
plot(VGS,ID);
xlabel("Gate to source voltage (Vgs)","fontsize",2)
ylabel("Drain current in milli ampere(Id)","fontsize",2)
```

Scilab code Exa 4.4 drain current and transconductance

```
// Example 4.4: drain current and transconductance
clc, clear
Idss=20; // maximum drain current in mili-ampere
Vp=-8; // pintc off voltage in volts
gmo=5000; // in micro seconds
Vgs=-4; // gate to source voltage in volts
Id=Idss*(1-(Vgs/Vp))^2;
gm=gmo*(1-(Vgs/Vp));
disp(Id,"drain current (mA) = ")
disp(gm,"transconductance (micro-second) = ")
```

Scilab code Exa 4.5 drain resistance

```
// Example 4.5: drain resisitance
clc, clear
Id=0.4; // drain current in mili-ampere
Vd=1; // drain voltage in volts
Vs=-5; // dc voltage in volts
Vss=-3; // dc voltage in volts
Vdd=5; // dc voltage in volts
MuCox=20; // in micro-ampere/volts
```

```
W=400; // in micro−metre
l=10; // in micro−metre
Id=((1/2)*(MuCox)*(W/l));
Rs=(Vss-Vs)/(Id*10^-3);
Rd=(Vdd-Vd)/(Id*10^-3);
disp("The values of the resistances are as follows :
    ");
disp("Resistance Rs is "+string(Rs)+" Kohm");
disp("Resistance Rd is "+string(Rd)+" Kohm");
```

Scilab code Exa 4.6 drain resistance

```
// Example 4.6: drain resisitance
clc, clear
//Given DATA
Vdd=10;//in volt
ID=0.4;//in mA
mu_nCox=20;//in uA/V^2
W=100;//in um
L=10;//in um
Vt=2;//in Volt
//Formula : ID=mu_n*Cox*W*(VGS−Vt)^2/(2*L)
VGS=sqrt(2*L*ID/(mu_nCox*10^-3*W))+(Vt);//in Volt
Vd=VGS;//
R=(Vdd-Vd)/ID;// resistance in killo ohms
disp(R,"drain resistance in killo ohms is")
```

Scilab code Exa 4.7 drain to source resistance

```
// Example 4.7: drain to source resisitance
clc, clear
//Given DATA
Vdd=5;//in volt
```

```
knwl=1;//in mA/V^2
Vd=0.1;//drain voltage
Vt=1;//in Volt
Id=Vt*((Vdd-Vt)*Vd- (1/2)*0.01);//drain current in milli ampere
Rd=(Vdd-Vd)/Id;// resistance in killo ohms
Rds= Vd/Id;//resistance in killo ohms
disp(Rds,"drain to source  resistance in killo ohms is")
```

Scilab code Exa 4.8 circuit analyze

```
// Example 4.8: Analyse the circuit
clc, clear
//Given DATA
Vdd=10;//in volt
ID=0.4;//in mA
knwl=1;//in mA/V^2
Vg=5;//gate voltage in volys
Vt=1;//in Volt
Rd=6'//drain resistance in killo ohms
Id=0.5;//in mA after solving the qudratic equation
Vs= Id*Rd;//source voltage in volts
Vd= Vdd-Rd*Id;//drain voltage in volts
Vgs= Vg-Rd*Id;//gate to source voltage in volts
disp(Vs,"source voltage in volts")
disp(Vd,"drain voltage in volts")
disp(Vgs,"gate to source voltage in volts")
disp(Id,"drain current in milli ampere")
disp("As Vd>Vg-Vt the transistor is operating at saturation as initially assumed")
```

Scilab code Exa 4.9 drain resistance

```
// Example 4.9: drain resisitance
clc, clear
//Given DATA
Vdd=5;//in volt
Id=0.5;//in mA
knwl=1;//in mA/V^2
Vt=-1;//in Volt
//Formula : ID=mu_n*Cox*W*(VGS-Vt)^2/(2*L)
VGS=sqrt((2*Id/knwl))+(Vt);//in Volt
Vd=3;//
Rd1=Vd/Id;//drain resistance in killo ohms
Vdm= Vd-Vt;//saturation mode operation
Rd2=Vdm/Id;//drain resistance in killo ohms
disp(Rd1,"drain resistance in killo ohms is")
disp(Rd2,"drain resistance in killo ohms is")
```

Scilab code Exa 4.10 channel width to channel length ratio and drain resistance

```
// Example 4.10: channel width to channel length
   ratio and drain resisitance
clc, clear
Id=100; // drain current in micro-ampere
kn=20; // in micro-ampere per volt^2
Vt=-1; // in volts
Vgs=0; // gate source voltage in volts
Vdd=5; // dc voltage in volts
Vd=1; // drain voltage in volts
wl=(2*Id/(kn*(Vgs-Vt)^2));
Rd=(Vdd-Vd)/(Id*10^-3);
disp(wl,"dchannel width to channel ratio ()")
disp(Rd,"drain resistance (in kilo ohm)")
disp("Rd can vary in the range 0 to 40 kilo-ohm")
```

Scilab code Exa 4.11 drain to source resistance

```
// Example 4.11: drain to source resisitance
clc, clear
//Given DATA
Vdd=10;//in volt
knwl=1;//in mA/V^2
Vd=0.1;//drain voltage
Vt=-1;//in Volt
Id=1*((-Vt)*Vd- (1/2)*0.01);//drain current in milli ampere
Rd=(Vdd-Vd)/Id;// resistance in killo ohms
Rds= Vd/Id;//resistance in killo ohms
disp(Rds,"drain to source  resistance in killo ohms is")
```

Scilab code Exa 4.12 input resistance

```
// Example 4.12:input resistance
clc, clear
//Given DATA
Vdd=15;//in volt
knwl=0.25;//in mA/V^2
Va=50;//voltage
Vt=1.5;//in Volt
Id=1.06;//drain current in milli ampre
Vd= 4.4;//drain oltage in volt
Vgs=Vd;//
gm=knwl*(Vgs-Vt);//transconductance in mA/V
ro=Va/Id;//output resistance in killo ohms
Rd=10;//drain resistance in killo ohms
Rg=10;//gate resistance in killo ohms
```

```
Rl=10;//load resistance in killo ohms
x=(Rd*Rl)/(Rd+Rl);//
Av= -gm*((x*ro)/(x+ro));//voltage gain
Ii=4.3;//input current in milli ampere
Ri= Rg/Ii;//input resistance in mega ohms
disp(Ri,"input resistance in mega ohms")
```

Chapter 5

FREQUENCY RESPONSE

Scilab code Exa 5.1 coupling capacitor

```
// Example 5.1:COUPLING CAPACITOR
clc;
clear;
close;
Rs=10;//series resistance in killo ohms
Xc1= Rs/10;//reactance at 20Hz
C1=(1/(2*%pi*20*Xc1*10^3))*10^6;//CAPACITANCE IN
    MICRO FARAD
disp(C1,"capacitance in micro farad is  as this is
    not a standar value will select 10 micro farad")
```

Scilab code Exa 5.2 amplifier gain

```
// Example 5.2:amplifier gain
clc;
clear;
close;
f=20;//frequency in hertz
```

```
Avm=100;//mid voltage gain
fl=40;//lower cut off frequency in hertz
fh=16;//lower cut off frequency in hertz
Avl= (Avm/(sqrt(1+(fl/f)^2)));//gain at lower cut
   off frequency
Avh= (Avm/(sqrt(1+(f/fh)^2)));//gain at upper cut
   off frequency
disp(Avl,"gain at lower cut off frequency")
disp(Avh,"gain at upper cut off frequency")
```

Scilab code Exa 5.3 amplifier gain

```
// Example 5.3:amplifier gain
clc;
clear;
close;
f=40;//frequency in hertz
Avm=40;//mid voltage gain
fl=40;//lower cut off frequency in hertz
Avl= (Avm/(sqrt(1+(fl/f)^2)));//gain at lower cut
   off frequency
disp(Avl,"gain at lower cut off frequency")
```

Scilab code Exa 5.4 amplifier gain

```
// Example 5.4:amplifier gain
clc;
clear;
close;
f=50;//frequency in hertz
Avm=150/0.707;//mid voltage gain
fh=20;//lower cut off frequency in hertz
```

```
Avh= (Avm/(sqrt(1+(f/fh)^2)));//gain at upper cut
    off frequency
disp(Avh,"gain at upper cut off frequency")
```

Scilab code Exa 5.5 maximum voltage gain

```
// Example 5.5:maximum voltage gain
clc;
clear;
close;
Avl=100;//voltage gain
Avm=Avl/0.708;//MID VOLTAGE GAIN
disp(Avm,"maximum voltage gain is")
```

Scilab code Exa 5.6 series capacitance and transfer function

```
// Example 5.6:series capacitance and transfer
    function
clc;
clear;
close;
f=100;//frequency in hertz
fc=25;//corner frequency
rs=2;//series resistance in killo ohms
rp=4;//PARALLEL resistance in killo ohms
Cs= (1/(2*%pi*fc*(rs+rp)*10^3))*10^6;//series
    capacitance in micro farad
ts= Cs*10^-6*(rs+rp)*10^3;//time constant
Tf= ((rp/(rs+rp))*((2*%pi*f*ts)/(sqrt(1+(2*%pi*f*ts)
    ^2))));//transfer function
disp(Cs,"series capacitance in micro farad")
disp(Tf,"transfer function is")
```

Scilab code Exa 5.7 corner frequency and maximum magnitude asymptote

```
// Example 5.7:corner frequency and maximum
   magnitude asymptote
clc;
clear;
close;
Cp=2;//PARALLEL RESISTANCE IN PICO FARAD
rs=2;//series resistance in killo ohms
rp=10;//PARALLEL resistance in killo ohms
tp= ((rs*rp)/(rs+rp)*10^3*Cp*10^-12);//time constant
f= (1/(2*%pi*tp))*10^-6;//corner frequency in mega
   hertz
Am= rp/(rp+rs);//maximum amplitude
Amd= 20*(log10(Am));//maximum magnitude aymptote is
   dB
disp(f,"corner frequency in mega hertz")
disp(Amd,"maximum magnitude aymptote is dB is")
```

Scilab code Exa 5.8 frequency and bandwidth

```
// Example 5.8:3-db frequency and bandwidth
clc;
clear;
close;
Cp=1;//PARALLEL capacitance IN PICO FARAD
Cs=2;//series capacitance IN micro FARAD
rs=1;//series resistance in killo ohms
rp=10;//PARALLEL resistance in killo ohms
ts= ((rs+rp)*10^3*Cp*10^-12);//time constant
tp= ((rs*rp)/(rs+rp)*10^3*Cp*10^-12);//time constant
```

```
fl= (1/(2*%pi*ts))*10^-6;//lower frequency in mega hertz
fh= (1/(2*%pi*tp))*10^-6;//upper frequency in mega hertz
BW=fh-fl;//bandwidth in mega hertz
disp(fl,"lower 3 dB frequency in mega hertz")
disp(fh,"upper 3 dB frequency in mega hertz")
disp(BW,"bandwidth in mega hertz is")
```

Scilab code Exa 5.9 frequency and bandwidth

```
// Example 5.9:3-db frequency and bandwidth
clc;
clear;
close;
Cp=1;//PARALLEL capacitance IN PICO FARAD
Cs=2;//series capacitance IN micro FARAD
rs=1;//series resistance in killo ohms
rp=10;//PARALLEL resistance in killo ohms
ts= ((rs+rp)*10^3*Cp*10^-12);//time constant
tp= ((rs*rp)/(rs+rp)*10^3*Cp*10^-12);//time constant
fl= (1/(2*%pi*ts))*10^-6;//lower frequency in mega hertz
fh= (1/(2*%pi*tp))*10^-6;//upper frequency in mega hertz
BW=fh-fl;//bandwidth in mega hertz
ts= (rs+rp)*10^3*Cp*10^-12;//open circuit time constant
tp= ((rs*rp)/(rs+rp))*10^3*Cp*10^-12;//short time constant
Ts= (rp)/(rs+rp)'//midband transfer function
Tsdb= 20*(log10(Ts));//midband transfer function in db
disp(ts,"open circuit time constant is")
disp(tp,"short circuit time constant is ")
```

```
disp(fl,"lower 3 dB frequency in mega hertz")
disp(fh,"upper 3 dB frequency in mega hertz")
disp(BW,"bandwidth in mega hertz is")
disp(Tsdb,"midband transfer function in db is")
```

Scilab code Exa 5.10 CORNER FREQUENCIES AND BANDWIDTH

```
// Example 5.9:3-db frequency and bandwidth
clc;
clear;
close;
Cp=1;//PARALLEL capacitance IN PICO FARAD
Cs=2;//series capacitance IN micro FARAD
rs=1;//series resistance in killo ohms
rp=2;//PARALLEL resistance in killo ohms
ts= ((rs+rp)*10^3*Cs*10^-6);//time constant
tp= ((rs*rp)/(rs+rp)*Cp*10^-12);//time constant
fl= (1/(2*%pi*ts));//lower frequency in  hertz
fh= (1/(2*%pi*tp));//upper frequency in  hertz
BW=fh-fl;//bandwidth in  hertz
ts= (rs+rp)*10^3*Cs*10^-12;//time constant
disp(ts," time constant in second is")
disp(fl,"lower 3 dB frequency in  hertz")
disp(fh,"upper 3 dB frequency in  hertz")
disp(BW,"bandwidth in hertz is")
```

Scilab code Exa 5.11 LOW FREQUENCY RESPOANSE

```
/// Example 5.10:low frequecy response
clc;
clear;
close;
Beta=100;//
```

```
Rs=1;//series resistance in killo ohms
R1=40;// resistance in killo ohms
R2=10;// resistance in killo ohms
hie=1.1;//in killo ohms
x=(R1*R2)/(R1+R2);//
Y=(x*hie)/(x+hie);//
Rin= Y+Rs;//input resistance in killo ohms
C1=10;//capacitance in micro farad
fc=(1/(2*%pi*Rin*10^3*C1*10^-6));//CUT OFF FREQUENCY OF INPUT RC NETWORK
Ce=20;//emitter capacitance in micro farad
hic=1100;//in ohms
Rth=(x*Rs)/(x+Rs)*10^3;//
Rx= (Rth+hic)/(Beta);//
Rl=2;//resistance in killo ohms
R= (Rx*Rl*10^3)/(Rx+Rl*10^3);//in ohms
fc1=(1/(2*%pi*R*Ce*10^-6));//CUT OFF FREQUENCY OF bypass RC NETWORK
Rl=1.8;//load resistance in killo ohms
Rc=4;//collector resistance in killo ohms
C2=1;//capacitance in micro farad
fc2=(1/(2*%pi*(Rl+Rc)*10^3*C2*10^-6));//CUT OFF FREQUENCY OF outPUT RC NETWORK
disp(fc,"CUT OFF FREQUENCY OF INPUT RC NETWORK in hertz")
disp(fc1,"CUT OFF FREQUENCY OF BYPASS RC NETWORK in hertz")
disp(fc2,"CUT OFF FREQUENCY OF OUTPUT RC NETWORK in hertz")
```

Scilab code Exa 5.12 CORNER FREQUENCY AND MAXIMUM GAIN

```
// Example 5.12:corner frequency and maximum GAIN
clc;
clear;
```

```
close;
Vcc=10;// Colector voltage in volts
Beta= 100;
Rc=1;// Collector resistance in killo ohms
Rs=600;//SERIES RESISTANCE IN OHMS
Re=0.2;// in kilo ohms
R1= 50;// in kilo ohms
R2= 10;// in kilo ohms
Vbe=0.7;// Base to emitter voltage in volts
C1=1;//capacitance in micro farad

Vth=Vcc * (R2/(R1+R2)); // vOLTAGE AT BASE


Rth= (R1*R2)/(R1+R2);
Ib=((Vcc-Vbe)/((Rth+(1+Beta)*Re)*10^3))*10^5;//in
    micro ampere
Icq= Beta*Ib*10^-3;//in milli ampere
Vt=26;//volate at room termprature in milli volts
gm= (Icq/Vt)*10^3;//transconductance in milli ampere
     per volts
rpi= (Beta*Vt*10^-3)/(Icq*10^-3);//resistance
Rb=Rth;//base resistance in killo ohms
x=(rpi+(1+Beta)*Re*10^3);//
y=(Rs+Rb*10^3);//
ts=((x*y)/(x+y))*C1*10^-3;//in milli second
fl= (1/(2*%pi*ts*10^-3));//corner frequency in hertz
Ri=(x*Rb*10^-3)/(Rb+x*10^-3);//
Av= ((gm*10^-3*rpi*Rc*10^3)*Rb*10^3)/((Ri+Rs*10^-3)
    *10^3*(x*10^-3+Rb)*10^3);
disp (fl,"corner frequency in hertz is")
disp(Av,"maximum gain is")
```

Scilab code Exa 5.16 OPEN CIRCUIT AND SHORT CIRCUIT TIME CONSTANTS VOLTAGE GAIN

```
// Example 5.15:TIME CONSTANTS , MIDBAND VOLTAGE
    GAIN AND COERNER FREQUENCIES
clc;
clear;
close;
Rl=4;//load resistance in killo ohms
Rs=250;//SERIES RESISTANCE IN OHMS
rpi= 2;//resistance IN KILLO OHMS
Re=0.2;// in kilo ohms
C1=2;//capacitance in micro farad
Cl=50;//capacitance in pico farad
ts=(Rs*10^-3+rpi)*10^3*C1*10^-3;//open circuit time
    constant in milli second
tp=Rl*Cl*10^-3;//short circuit time constant in
    micro second
gm= 6.5//transconductance in milli ampere per volts
Av= (((gm*10^-3*rpi*10^3*Rl*10^3))/(Rs*10^-3+rpi)
    *10^3)*10^-5;//mid voltage gain
fl=(1/(2*%pi*ts*10^-3));//lower cut off frequency in
     hertz
fh=(1/(2*%pi*tp*10^-6))*10^-6;//upper cut off
    frequency in mega hertz
disp (ts,"open circuit time constant in milli second
     is")
disp(tp,"short circuit time constant in micro second
    ")
disp(Av,"maximum gain is")
disp(fl,"lower cut off frequency in hertz")
disp(fh,"upper cut off frequency in mega hertz")
```

Scilab code Exa 5.17 LOW FREQUENCY RESPONSE

```
// Example 5.16:frequency response
clc;
clear;
```

```
close;
Rg=10;//resistance in mega ohms
Vgs=10;//gate to soure voltage
Igss=10;//current in nano ampere
x= (Vgs/Igss)*1000;//resistance in mega ohms
Rin= ((Rg*x)/(Rg+x));//input resistance in mega ohms
C1=0.001;//capacitance in micro farad
fc= (1/(2*%pi*Rin*10^6*C1*10^-6));//input critical
    frequency of the RC network
Rd=1.8;//drain resistance in killo ohms
Rl=18;//load resistance in killo ohms
C2=1;//Capacitance in micro farad
fc1=(1/(2*%pi*(Rd+Rl)*10^3*C2*10^-6));//output
    critical frequency of the RC network
disp(fc,"input critical frequency of the RC network
    in hertz")
disp(fc1,"input critical frequency of the RC network
     in hertz")
```

Scilab code Exa 5.18 fB

```
// Example 5.16:fb
clc;
clear;
close;
rpi=2;//resistance in killo ohms
Cpi=1.8;//capacitance in pico farad
Cmu=0.12;//capacitance in pico farad
fb=(1/(2*%pi*rpi*10^3*(Cpi+Cmu)*10^-6));//frequency
    in mega hertz
disp(fb,"frequency in mega hertz")
```

Scilab code Exa 5.19 BANDWIDTH AND CAPACITANCE

```
// Example 5.18:bandwidth and capacitance
clc;
clear;
close;
Vt=26;//voltage in milli volts
ft=500;//frequecy in mega hertz
Ic=1;//collector current in mili ampere
Bo=90;//
fb=ft/Bo;//frequency in mega hertz
Cmu=0.2;//capacitance in pico farad
x= ((Ic*10^-3)/(2*%pi*Vt*10^-3*ft*10^6))*10^12;//
Cpi= x-Cmu;//
disp(fb,"bandwidth in mega hertz")
disp(Cpi,"capacitance of the transistor in pico
   farad")
```

Scilab code Exa 5.20 3 DB FREQUECY RESPONSE

```
// Example 5.19:corner frequency
clc;
clear;
close;
Rs=1;//series resistance in killo ohms
Rl=3.7;//load resistance in killo ohms
Rc=3.7;// Collector resistance in killo ohms
R1= 200;// in kilo ohms
R2= 200;// in kilo ohms
Vbe=0.7;// Base to emitter voltage in volts
Rb= (R1*R2)/(R1+R2);
rpi=2.5;//resistance in killo ohms
Cpi=0.18;//capacitance in pico farad
gm=40;//transconductance in milli ampere per volts
y=(Rc*Rl)/(Rc+Rl);//
Cmu= Cpi*(1+gm*y);//
Cm2=Cmu;//
```

```
z=(Rs*rpi)/(Rs+rpi);//
R=(Rb*z)/(Rb+z);//
C=Cmu+4;//
f3db= (1/(2*%pi*R*10^3*C))*10^6;//3-dB frequency in
    mega hertz
C1=4;//capacitance in pico farad
f3db1= (1/(2*%pi*R*10^3*C1))*10^6;//3-dB frequency
    in mega hertz
disp(f3db,"3-dB frequency in mega hertz due to
    miller effect")
disp(f3db1,"3-dB frequency in mega hertz")
disp("due to miller effect the capacitance gets
    multiplied by 75 .hence due to miller effect the
    bandwidth is reduced")
```

Scilab code Exa 5.21 MIDBAND GAIN AND UPPER 3DB FREQUENCY

```
// Example 5.20:mid band gain and upper 3 db
    frequency
clc;
clear;
close;
Cpi=40;//in pico farad
Vt=26;//voltage in milli volts
Beta=150;//
Icc=1;//current in milli ampere
rpi= ((Beta*Vt)/Icc)*10^-3;//
Icq=1;//current in milli ampere
gm=(Icq/Vt)*10^3;//transconductance in mili ampere
    per volt
Rc=4.7;//collector resistance in killo ohms
Rl=10;//load resistance in killo ohms
Rld= (Rc*Rl)/(Rc+Rl);//
Cmu=3;//capacitance in pico farad
Cm=round(Cmu*(1+gm*Rld));//miller capacitance in
```

```
pico farad
R1= 50;// in kilo ohms
R2= 5;// in kilo ohms
Rb= (R1*R2)/(R1+R2);
rs=1;//in killo ohms
x=(Rb*rs)/(Rb+rs);//
y=(rpi*x)/(rpi+x);//
fh=(1/(2*%pi*y*10^3*(Cmu+Cpi)*10^-6));//3-db upper cut off frequency in mega hertz
z=(Rb*rpi)/(Rb+rpi);//
Avm=(gm*Rld*z)/(z+rs);//
disp(fh,"3-db upper cut off frequency in mega hertz is")
disp(Avm,"MIDBAND GAIN")
```

Scilab code Exa 5.22 MIDBAND GAIN AND UPPER 3DB FREQUENCY

```
// Example 5.21:mid band gain and upper 3 db frequency
clc;
clear;
close;
Cpi=40;//in pico farad
Vt=26;//voltage in milli volts
Beta=150;//
Icq=1;//current in milli ampere
rpi= ((Beta*Vt)/Icq)*10^-3;//
gm=(Icq/Vt)*10^3;//transconductance in mili ampere per volt
rs=1;//in killo ohms
re=0.5;//in killo ohms
g=(rs*re)/(rs+re);//
m=rpi/(1+Beta);//
tpi= ((m*g)/(m+g))*Cpi*10^-7;//
fh1=(1/(2*%pi*tpi*10^4));//first 3-db upper cut off
```

```
frequency in mega hertz
Rc=4.7;//collector resistance in killo ohms
Rl=10;//load resistance in killo ohms
Rld= (Rc*Rl)/(Rc+Rl);//
Cmu=3;//capacitance in pico farad
R1= 50;// in kilo ohms
R2= 5;// in kilo ohms
Rb= (R1*R2)/(R1+R2);
fh2=(1/(2*%pi*Cmu*10^-8*Rld*10^3))*10^-2;//second 3-db upper cut off frequency in mega hertz
x=(m*re)/(m+re);///
Avm=(gm*Rld*x)/(x+rs);//
disp(fh1,"3-db upper cut off frequency in mega hertz is")
disp(fh2,"second 3-db upper cut off frequency in mega hertz")
disp(Avm,"MIDBAND GAIN")
```

Scilab code Exa 5.23 MIDBAND GAIN AND UPPER 3DB FREQUENCY

```
// Example 5.22:mid band gain and upper 3 db frequency
clc;
clear;
close;
Cmu=3;//capacitance in pico farad
Cpi=40;//in pico farad
Vt=26;//voltage in milli volts
Beta=150;//
Icq=1;//current in milli ampere
rpi= ((Beta*Vt)/Icq)*10^-3;//
gm=(Icq/Vt)*10^3;//transconductance in mili ampere per volt
rs=1;//in killo ohms
re=4.7;//in killo ohms
```

```
R1= 40;// in kilo ohms
R2= 20;// in kilo ohms
R3= 27;// in kilo ohms
Rb=(R2*R3)/(R2+R3);//
g=(rs*rpi)/(rs+rpi);//
tp1=(((Rb*g)*(Cpi+2*Cmu))/(Rb+g))*10^-9;//in second
m=rpi/(1+Beta);//
tp2= m*(Cmu+Cpi)*10^-9;//
Rc=4.7;//collector resistance in killo ohms
Rl=10;//load resistance in killo ohms
Rld= (Rc*Rl)/(Rc+Rl);//
tp3=Cmu*10^-12*Rld*10^3;//in second
fh1=(1/(2*%pi*tp1*10^6));//first 3-db upper cut off
    frequency in mega hertz
fh2=(1/(2*%pi*tp2*10^6));//second 3-db upper cut off
     frequency in mega hertz
fh3=(1/(2*%pi*tp3*10^6));//third 3-db upper cut off
    frequency in mega hertz
Avm= -gm*Rld*(rpi/(rpi+1));//
disp(fh1,"3-db upper cut off frequency in mega hertz
     is")
disp(fh2,"second 3-db upper cut off frequency in
    mega hertz")
disp(fh3,"third 3-db upper cut off frequency in mega
     hertz")
disp(Avm,"MIDBAND GAIN")
```

Scilab code Exa 5.24 UPPER AND LOWER CUT OFF FREQUENCY

```
// Example 5.23:corner frequency and bandwidth
clc;
clear;
close;
tr=16;//rise time in micro second
V=100;//voltage in milli volts
```

```
Vd=90;//voltage in milli volts
f=5;//frequecny in killo hertz
fh= (0.35/(tr*10^-6))*10^-3;//upper cut off
   frequency in killo hertz
P= ((V-Vd)/V)*100;//
fl=(P*10^3*f)/(100*%pi);//lower cut off frequency in
    hertz
BW=(fh*10^3-fl)*10^-3;//bandwith in killo hertz
disp(fh,"upper cut off frequency in killo hertz")
disp(fl,"lower cut off frequency in hertz")
disp(BW,"bandwith in killo hertz")
```

Scilab code Exa 5.25 PERCENTAGE TILT

```
// Example 5.24:PERCENTAGE TILT
clc;
clear;
close;
Rc=4;//RESISTANCE IN KILLO OHMS
Rl=2;//RESISTANCE IN KILLO OHMS
R1=Rc+Rl;//
C=10;//capacitance in micro farad
fl=(1/(2*%pi*R1*10^3*C*10^-6));//LOWER CUT -OFF
   FREQUENCY
f=200;//frequency in hertz
P= (%pi*fl)/f;//
disp(P*100,"percentage tilt is")
```

Scilab code Exa 5.26 PERCENTAGE TILT AND LOWEST INPUT FREQUENCY

```
// Example 5.25:PERCENTAGE TILT
clc;
```

```
clear;
close;
Rc=2;//RESISTANCE IN KILLO OHMS
Rl=10;//RESISTANCE IN KILLO OHMS
R1=Rc+Rl;//
C=10;//capacitance in micro farad
fl=(1/(2*%pi*R1*10^3*C*10^-6));//LOWER CUT -OFF
    FREQUENCY
f=100;//frequency in hertz
P= (%pi*fl)/f;//
p1=0.02
f=(%pi*fl)/p1;//
disp(P*100,"percentage tilt is")
disp(f,"as the input frequency increases the
    percentage tilt decreases")
```

Scilab code Exa 5.27 LOWER AND UPPER CUT OFF FREQUENCY

```
// Example 5.26:fh,fl and bandwidth
clc;
clear;
close;
fln=25;//in hertz
fhn=16;//in kelo hertz
n=3;//
x=sqrt(2^(1/n)-1);//
fl=x*fln;//lower cut off frequency in hertz
fh=fhn/x;//upper cut off frequency in hertz
BW=fh-fl*10^-3;//bandwidth
disp(fl,"lower cut off frequency in hertz")
disp(fh,"upper cut off frequency in killo hertz")
disp(BW,"bandwidth in killo hertz")
```

Scilab code Exa 5.28 OVERALL BANDWIDTH

```
// Example 5.27:bandwidth
clc;
clear;
close;
fl=40;//in hertz
fh=20;//in kelo hertz
n=4;//
x=sqrt(2^(1/n)-1);//
fhn=x*fh;//lower cut off frequency in hertz
fln=fl/x;//upper cut off frequency in hertz
BW=fhn-fln*10^-3;//bandwidth
disp(fln,"lower cut off frequency in hertz")
disp(fhn,"upper cut off frequency in killo hertz")
disp(BW,"bandwidth in killo hertz")
```

Scilab code Exa 5.29 UPPER AND LOWER CUT OFF FREQUENCY

```
// Example 5.28:fh,fl
clc;
clear;
close;
fln=20;//in hertz
fhn=100;//in kelo hertz
n=3;//
x=sqrt(2^(1/n)-1);//
fl=x*fln;//lower cut off frequency in hertz
fh=fhn/x;//upper cut off frequency in hertz
disp(fl,"lower cut off frequency in hertz")
disp(fh,"upper cut off frequency in killo hertz")
```

Scilab code Exa 5.30 VOLTAGE GAIN UPPER CUT OFF FREQUENCY AND COUPLING CAPACITOR

```
// Example 5.29:Avm,Fh,Cc
clc;
clear;
close;
mu=70;//
rd=44;//resistance in killo ohms
gm= mu/(rd);//transconductane in milli ampere per
   volt
Rd2=50;//resistance in killo ohms
x=(rd*Rd2)/(rd+Rd2);//
Av2m= gm*x;//mid frequency gain of second stage
Rg=1;//gate resisatnce in mega ohms
y= (x*Rg*10^3)/(x+Rg*10^3);//
Av1m= -gm*y;//mid frequency gain of first stage
Av= Av1m*Av2m;//total gain
Req=y;//
Csh=200;//capacitance in pico farad
fh=(1/(2*%pi*Req*10^3*Csh*10^-9));//upper cut off
   frequency in killo hertz
Ro1=x;//
fl=50;//
Cc=(1/(2*%pi*fl*(Ro1*10^3+Rg*10^6)))*10^9;//coupling
    capacitance in nano farad
disp(Av2m,"mid frequency gain of second stage")
disp(fh,"upper cut off frequency in killo hertz")
disp(Cc,"coupling capacitance in nano farad")
```

Scilab code Exa 5.31 GAIN OF OVERALL AMPLIFIER

```
// Example 5.28:gain
clc;
clear;
```

```
close;
gm= 10;//transconductane in milli ampere per volt
Csh=20;//capacitance in pico farad
BW=10;//bandwidth in mega hertz
fhn=10;//in mega hertz
n=2;//
x=sqrt(2^(1/n)-1);//
fh=fhn/x;//lower cut off frequency in mega hertz
R=(1/(2*%pi*Csh*10^-12*fh*10^6));//resiatnce in ohms
Av1=-gm*R*10^-3;//mid frequency gain of first stage
Av2=Av1;//mid frequency gain of second stage
Av= Av1*Av2;//total gain
Avdb=20*(log10(Av));//total gain dB
disp(Avdb,"total gain in dB is")
```

Scilab code Exa 5.32 OVERALL VOLTAGE GAIN LOWER CUT OFF FREQUENCY AND UPPER CUT OFF FREQUENCY

```
// Example 5.31:Avm,Fh,Fl
clc;
clear;
close;
n=2
C=50;//in micro farad
Cc=0.1;//in micro farad
rd=50;//resis
Rs=1;//series resistance in killo ohmstance in killo
    ohms
gm= 2;//transconductane in milli ampere per volt
Rd=10;//resistance in killo ohms
x=(rd*Rd)/(rd+Rd);//
Av2m= -gm*x;//mid frequency gain of second stage
Rg=1;//gate resisatnce in mega ohms
y= (x*Rg*10^3)/(x+Rg*10^3);//
Avm= -gm*y;//mid frequency gain of first stage
```

```
Av= Avm*Av2m;//total gain
Avdb=20*(log10(Av));//
Req=y;//
Csh=10;//capacitance in pico farad
fh=(1/(2*%pi*Req*10^3*Csh*10^-6));//upper cut off frequency in mega hertz
Ro1=y;//
fl=(1/(2*%pi*Cc*10^-6*Ro1*10^3));//lower cut off frequency in hertz
x=sqrt(2^(1/n)-1);//
fhn=x*fh;//lower cut off frequency in hertz
fln=fl/x;//upper cut off frequency in hertz
disp(Avdb,"total voltage gain in db")
disp(fl,"lower cut off frequency in hertz")
disp(fh,"upper cut off frequency in mega hertz")
disp(fln,"3 db lower cut off frequency in hertz")
disp(fhn,"3 db upper cut off frequency in mega hertz")
```

Scilab code Exa 5.33 MIDBAND VOLTAGE GAIN CUT OFF FREQUENCIES

```
// Example 5.32:Avm,Fh,Fl
clc;
clear;
close;
n=3
Cc=0.005;//in micro farad
C=100;//in pico farad
rd=7.7;//
Rs=1;//series resistance in killo ohmstance in killo ohms
gm= 25;//transconductane in milli ampere per volt
Rd=10;//resistance in killo ohms
x=(rd*Rd)/(rd+Rd);//
```

```
Av2m= -gm*x;//mid frequency gain of second stage
Rg=1;//gate resisatnce in mega ohms
y= (x*Rg*10^3)/(x+Rg*10^3);//
Avm= -gm*y;//mid frequency gain of first stage
Av= Avm*Avm*Avm;//total gain
Avdb=20*(log10(-Av));//
Req=y;//
Csh=100;//capacitance in pico farad
fh=(1/(2*%pi*Req*10^3*Csh*10^-9));//upper cut off frequency in killo hertz
Ro1=y;//
fl=(1/(2*%pi*Cc*10^-6*(Ro1*10^3+Rg*10^6)));//lower cut off frequency in hertz
x=sqrt(2^(1/n)-1);//
fhn=x*fh;//lower cut off frequency in hertz
fln=fl/x;//upper cut off frequency in hertz
disp(Avdb,"total voltage gain in db")
disp(fl,"lower cut off frequency in hertz")
disp(fh,"upper cut off frequency in killo hertz")
disp(fln,"3 db lower cut off frequency in hertz")
disp(fhn,"3 db upper cut off frequency in killo hertz")
```

Chapter 6

FEEDBACK

Scilab code Exa 6.1 gain

```
// Example 6.1;// Gain
clc;
clear;
close;
a=60;// OPEN LOOP VOLTAGE GAIN IN dB
A= 10^(a/20);// open voltage gain
Beta= (1/20);// feedback ratio
Af= (A/(1+(Beta*A)));//GAIN WITH FEEDBACL
AfdB= 20*(log10(Af));//gain with feedback in dB
disp(AfdB,"gain with feedback in dB is")
```

Scilab code Exa 6.2 feedback factor

```
// Example 6.2;// feedback factor
clc;
clear;
close;
a=60;// OPEN LOOP VOLTAGE GAIN IN dB
```

```
A= 10^(a/20);// open voltage gain
AfdB=40;//gain with feedback in dB
Af= 10^(AfdB/20);//GAIN WITH FEEDBACK
BetaA= (A/Af)-1;// feedback factor
disp(BetaA,"feedback factor is")
```

Scilab code Exa 6.3 feedback output

```
// Example 6.3;// feedback output
clc;
clear;
close;
A= 600;// open voltage gain
Af=50;//
Beta=( (A/Af)-1)/A;// feedback ratio
fop= (Beta*100);//percentage of output voltage which
    is fedback to the input is
disp(fop,"percentage of output voltage which is
   fedback to the input is ")
```

Scilab code Exa 6.4 feedback ratio

```
// Example 6.3;// feedback ratio
clc;
clear;
close;
Vo= 5;// output voltage
Vin=0.1;//input voltage without feedback
A= Vo/Vin;// Gain without feedback
Vin1=0.2;//input voltage with feedback
Af= Vo/Vin1;// Gain with feedback
Beta=( (A/Af)-1)/A;// feedback ratio
disp(Beta,"feedback ration is ")
```

Scilab code Exa 6.5 Change in gain

```
// Example 6.5;// Change in gain
clc;
clear;
close;
A= 1000;// open loop voltage gain
Beta= 0.002;// feedback ratio
Af= (A/(1+(Beta*A)));//GAIN WITH FEEDBACL
A1= (1-0.15)*A;//new open loop voltage gain
Af1= (A1/(1+(Beta*A1)));//GAIN WITH FEEDBACL
dA=((Af-Af1)/Af)*100;// Change in overall gain in
   percentage
disp(dA,"Change in overall gain in percentage is")
```

Scilab code Exa 6.6 open loop voltage gain

```
// Example 6.6;// open loop voltage gain
clc;
clear;
close;
Af= 100;//GAIN WITH FEEDBACK
dAf=1/100;// OPEN LOOP VOLTAGE GAIN
dA= 10/100;// open voltage gain
BetaA=(dA/dAf)-1;// feedback factor
A=Af*(1+BetaA);//open loop voltage gain
disp(A,"open loop voltage gain is")
```

Scilab code Exa 6.7 open loop voltage gain and negaive feedback

```
// Example 6.7;// open loop voltage gain & negaive
   feedback
clc;
clear;
close;
Af= 100;//GAIN WITH FEEDBACK
dAf=0.1/100;// OPEN LOOP VOLTAGE GAIN
dA= 10/100;// open voltage gain
BetaA=(dA/dAf)-1;// feedback factor
A=Af*(1+BetaA);//open loop voltage gain
NF= Af/A;//amount of negative feedback
disp(A,"open loop voltage gain is")
disp(NF,"amount of negative feedback is")
```

Scilab code Exa 6.8 INPUT VOLTAGE AND OUTPUT VOLTAGE

```
// Example 6.8;// GAIN,INPUT VOLTAGE AND OUTPUT
   VOLTAGE
clc;
clear;
close;
Vs=10;//output voltage in milli volts
Vi= 0.01;//input voltage in volts
A=200;//amplifier gain without feedback
D=0.1;//distortion without feedback
Df=0.01;//distortion with feedback
Beta=( (D/Df)-1)/A;// feedback ratio
fop= (Beta*100);//percentage of output voltage which
    is fedback to the input is
Af= (A/(1+(Beta*A)));//GAIN WITH FEEDBACL
Vo= Af*Vs*10^-3;//new output volate in volts
Vin= (Vi +(-Beta*Vo))*10^3;//new input voltage in
   milli volts
disp(Af,"gain with feedback  is")
disp(Vo,"new output volate in volts")
```

```
disp(Vin,"new input voltage in milli volts is")
```

Scilab code Exa 6.9 distortion AND close loop gain

```
// Example 6.8;// INPUT VOLTAGE ,distortion AND
   close loop gain
clc;
clear;
close;
Vs=10;//output voltage in milli volts
A=1000;//amplifier gain without feedback
D=0.1;//distortion without feedback
BetaAd=40;//FEEDBACK FACTOR IN dB
BetaA=10^(BetaAd/20);// feedback ratio
Df= ((D/(1+BetaA)))*100;//distortion in percentage
   with feedbck
Af= (A/(1+(BetaA)));//GAIN WITH FEEDBACL
Vo= Vs*(1+BetaA)*10^-3;//new output volate in volts
disp(Vo,"new output volate in volts")
disp(Df,"distortion in percentage with feedbck is")
disp(Af,"gain with feedback  is")
```

Scilab code Exa 6.10 input and output impedance

```
// Example 6.10;//input & output impedance
clc;
clear;
close;
A= 10000;// open voltage gain
Beta=0.02;// feedback ratio
Zi=1;//input impedance without feedback in kiilo
   ohms
```

```
Zo=10;//output impedance without feedback in kiilo ohms
Zif= (1+A*Beta)*Zi;//input impedance with feedback in kiilo ohms
Zof=(Zo/(1+Beta*A))*10^3;//output impedance with feedback in  ohms
disp(Zif,"input impedance with feedback in kiilo ohms is ")
disp(Zof,"output impedance with feedback in ohms is ")
```

Scilab code Exa 6.11 feedback factor and Change in gain

```
// Example 6.11;// feedback factor and Change in gain
clc;
clear;
close;
Zi=1;//input impedance without feedback in kiilo ohms
Zo=10;//output impedance without feedback in kiilo ohms
Zof=1;//output impedance with feedback in killo ohms
A= 1000;// open loop voltage gain
Beta=( (Zo/Zof)-1)/A;// feedback ratio
BetaA= Beta*A;//feedback factor
A1= (1-0.1)*A;//new open loop voltage gain
Af=100;//FEEDBACK
Af1= (A1/(1+(Beta*A1)));//GAIN WITH FEEDBACL
dA=((Af-Af1)/Af)*100;// Change in overall gain in percentage
disp(BetaA,"feedback factor is")
disp(dA,"Change in overall gain in percentage is")
```

Scilab code Exa 6.12 gain and frequency

```
// Example 6.12;// Avf,Fhf,Flf
clc;
clear;
close;
Fh=20;//upper cutoff frequency in killo hertz
   without feedback
Fl=30;//upper cutoff frequency in hertz without
   feedback
Av= 50000;// open loop voltage gain
Beta=5*10^-5;// feedback ratio
Avf= (Av/(1+(Beta*Av)));//GAIN WITH FEEDBACL
Fhf=Fh*(1+Av*Beta);//uppor cutoff frequency with
   feedback in killo hertz
Flf=Fl/(1+Av*Beta);//lower cutoff frequency with
   feedback in hertz
disp(Fhf,"uppor cutoff frequency with feedback in
   killo hertz")
disp(Flf,"lower cutoff frequency with feedback in
   hertz")
```

Scilab code Exa 6.13 feedback factor and bandwidth

```
// Example 6.12;//feedback factor and bandwidth
clc;
clear;
close;
B=4;//bandwidth in mega hertz without feedback
Av= 1500;// open loop voltage gain
Avf= 150;//GAIN WITH FEEDBACk
AvB= ((Av/Avf)-1);//feedback factor
```

```
BWf=(1+AvB)*B;//bandwidth in mega hertz with
    feedback
disp(AvB,"FEEDBACK FACTOR IS")
disp(BWf,"bandwidth in mega hertz with feedback is")
```

Scilab code Exa 6.14 voltage gain and input and output resistance

```
// Example 6.14;//voltage gain ,input & output
    resistance
clc;
clear;
close;
A= 500;// open voltage gain
Beta=0.01;// feedback ratio
Ri=3;//input resistance without feedback in kiilo
    ohms
Ro=20;//output resistance without feedback in kiilo
    ohms
Af=(A/(1+A*Beta));//Voltage gain is
Rif= (1+A*Beta)*Ri;//input RESISTANCE with feedback
    in kiilo ohms
Rof=(Ro/(1+Beta*A));//output resistance with
    feedback in killo ohms
disp(Rif,"input resistance with feedback in kiilo
    ohms is ")
disp(Rof,"output resistance with feedback in killo
    ohms is ")
```

Scilab code Exa 6.15 INPUT IMPEDANCE

```
// Example 6.15;//INPUT IMPEDANCE
clc;
clear;
```

```
close;
Beta=100;//gain
Rl=18.6;//load resistance in killo ohms
Re=9.3;//emitter resistance in killo ohms
Vbe=0.7;//
Vcc=10;//collector voltage in volts
R1=10;//resistance in killo ohms
R2=10;//resistance in killo ohms
V2= Vcc*(R2/(R1+R2));// voltage at resistor R2
Ve=V2-Vbe;//volate at emitter
Ie=Ve/Re;// Emitter current in milli ampere
re=(25/Ie);//AC emitter resistance
Re=(Rl*Re)/(Rl+Re);//effective emitter resistance in killo ohms
Zib=Beta*(Re*10^3+re)*10^-3;//INPUT IMPEDANCE TO THE BASE IN KILLO OHMS
x=(R1*R2)/(R1+R2);//resistance in killo ohms
Zi=(Zib*x)/(Zib+x);//input impedance of the emitter follower in killo ohms
disp(Zi,"input impedance of the emitter follower in killo ohms is")
```

Scilab code Exa 6.16 gain

```
// Example 6.16;//gain
clc;
clear;
close;
gm=4000;//gain in micro second
Ro=10;//output resistance in killo ohms
Rd=10;// resistance in killo ohms
Rl=(Ro*Rd)/(Ro+Rd);//load resistance in killo ohms
A= -(gm*10^-6*Rl*10^3);//gain without feedback
R1=80;//resistance in killo ohms
R2=20;//resistance in killo ohms
```

```
Beta= -(R2/(R1+R2));//feedback factor
Af=(A/(1+A*Beta));//gain with feedback
disp(A,"gain without feedback is")
disp(Af," gain with feedback is")
```

Scilab code Exa 6.17 gain

```
// Example 6.17;//gain
clc;
clear;
close;
R1=1.8;//resistance in killo ohms
R2=0.2;//resistance in killo ohms
Beta= (R2/(R1+R2));//feedback factor
A=100000;//gain without feedback
Af1=(A/(1+A*Beta));//gain with feedback
Af=(1/Beta);//AS A*Beta>>1
disp(Af," gain with feedback AS A*Beta>>1 is")
```

Scilab code Exa 6.18 voltage gain and resistance

```
// Example 6.18;//Av,Rif,Avf,Rof
clc;
clear;
close;
Rs=600;//Internal resistance in ohms
Rl=2;//Load resistance in killo ohms'
Rb=40;//base resistance in killo ohms
//H Paramters are
hie=5;//in killo ohms
hre=80;
hfe=80;
RL1=(Rb*Rl)/(Rb+Rl);//load resistance in killo ohms
```

```
Av=(-(hfe*(RL1*10^3/hie*10^3)))*10^-6;// Voltage Gain
x=(Rb*10^3/(1-Av));//
Rif= (hie*10^3*x)/(hie*10^3+x)//input resistance with feedback
Avf=(Av*Rif)/(Rif+Rs);// Overall Voltage gain
Rof=((Rb*10^3*(Rs+hie*10^3))/(Rs*hfe))*10^-3;// output resistance with feedback
Rof1=(Rof*Rl)/(Rof+Rl);// output resistance with feedback in killo ohms
disp(Av,"Voltage Gain is")
disp(Rif,"input resistance with feedback in ohms is")
disp(Avf,"Overall Voltage gain is")
disp(Rof1,"output resistance with feedback in killo ohms")
```

Scilab code Exa 6.19 loop gain

```
// Example 6.19;//A,Beta,Rif,Af amd loop gain
clc;
clear;
close;
R1=1;//resistance in killo ohms
R2=20;// resistance in killo ohms
Re=100;//emitter resistance in  ohms
//H Paramters are
hie=2;//in killo ohms
hfe=80;
Rl=1;//load resistance in killo ohms
Ri=hie;//input resistance in killo ohms
A= -(hfe*Rl*10^3)/(hie*10^3);//
Beta=Re/(Rl*(10^3));//GAIN
Rif= (hie*10^3+(1+hfe)*Re)*10^-3//input resistance with feedback in killo ohms
```

```
Av=(-(hfe*(Rl*10^3/Rif*10^3)))*10^-6;// Voltage Gain
BetaA= Beta*A;//loop gain
BetaAd= 20*(log10(-BetaA));//loop gain in dB
disp(A,"Voltage Gain is")
disp(Beta,"Gain is")
disp(Rif,"input resistance with feedback in killo
   ohms is")
disp(Av," Voltage gain with feedback is")
disp(BetaAd,"loop gain in dB is")
```

Scilab code Exa 6.20 voltage gain

```
// Example 6.20;//voltage gain
clc;
clear;
close;
re=7.5;//A.C. Resistance
R1=470;//resistance in  ohms
Rc=2.2;// resistance in killo ohms
Re=510;//emitter resistance in  ohms
//H Paramters are
hie=900;//in  ohms
hfe=120;
A=-(hfe)/(hie+Re);///gain without feedback
Beta=-Re;//gain
GF= (1+A*Beta);//gain factor
Af=A/(GF);//GAIN WITH FEEDBACK
Avf= Af*Rc*10^3;//voltage gain with feedback
Av= -(Rc*10^3/re);//voltage gain without feedback
disp(Avf,"voltage gain with feedback is")
disp(Av,"voltage gain without feedback is")
```

Scilab code Exa 6.21 change in overall gain

```
// Example 6.21;// change in overall gain
clc;
clear;
close;
Beta=0.01;//feedback
Ad= 60;//gain in dB
A= 10^(Ad/20);//gain
dA= 11;// open voltage gain
dAf= (1/(1+Beta*A))*dA;//GAIN WITH FEEDBACK
disp(dAf,"change in overall gain is in percentage")
disp("the result clearly shows that the percentage
    change reduction in overall gain with negative
    feedback is reduced from 11 to 1 percent .That is
     why we say that amplifier with negative feedback
     have stable gain")
```

Scilab code Exa 6.22 input impedence with feedback

```
// Example 6.22;// input impedence with feedback
clc;
clear;
close;
A= 1000;// open voltage gain
Beta=0.005;// feedback ratio
Zi=2;//input impedance without feedback in kiilo
    ohms
Zif= (1+A*Beta)*Zi;//input impedance with feedback
    in kiilo ohms
disp(Zif,"input impedance with feedback in kiilo
    ohms is")
```

Scilab code Exa 6.23 feedback factor and change in overall gain

```
// Example 6.23;// feedback factor and change in
   overall gain
clc;
clear;
close;
Zo=12.6;//output impedance in killo ohms
Zofb=600;//output impedance in ohms with feedback
Ad= 60;//gain in dB
A= 10^(Ad/20);//gain
Beta= ((Zo*10^3/Zofb)-1)/A;//feedback factor
dA= 10;// open voltage gain
dAf= (1/(1+Beta*A))*dA;//GAIN WITH FEEDBACK
disp(Beta,"feedbck factor is")
disp(dAf,"change in overall gain is in percentage")
```

Scilab code Exa 6.24 feedback fraction overall voltage gain and output voltage

```
// Example 6.24;// feedback fration ,overall voltage
    gain and output voltage
clc;
clear;
close;
A=5000;//gain wtihout feedback
R1=1;//resistance in killo ohms
R2=9;//resistance in killo ohms
Beta= R1/(R1+R2);//feedback fraction
Afb=round(A/(1+Beta*A));//overall gain
Vs=2;//input voltage without feedback in milli volts
Vo= round(Afb*Vs);//output voltage with feedback in
   milli volts
disp(Beta,"feedback fraction is")
disp(Afb,"overall voltage gain")
disp(Vo,"output voltage with feedback in milli volts
   ")
```

Scilab code Exa 6.25 overall gain and impedence

```
// Example 6.25;//feedback fraction ,overall voltage gain,input impedance ,output impedance and output volatge
clc;
clear;
close;
Zi=5;//input impedance in killo ohms
Zo=100;//input impedance in ohms
A=10000;//gain wtihout feedback
R1=2;//resistance in killo ohms
R2=18;//resistance in killo ohms
Beta= R1/(R1+R2);//feedback fraction
Afb=round(A/(1+Beta*A));//overall gain
Zif= round((1+A*Beta)*Zi*10^-3);//input impedance with feedback in mega ohms
Zof= Zo/(1+Beta*A);//OUTPUT impedance with feedback in ohms
Vs=10;//input voltage without feedback in milli volts
Vo= round(Vs/Afb);//output voltage with feedback in milli volts
disp(Beta,"feedback fraction is")
disp(Afb,"overall voltage gain")
disp(Zif,"input impedance with feedback in mega ohms")
disp(Zof,"OUTPUT impedance with feedback in ohms")
disp(Vo,"output voltage with feedback in milli volts")
```

Scilab code Exa 6.26 gain

```
// Example 6.26;// Gain
clc;
clear;
close;
a=60;// OPEN LOOP VOLTAGE GAIN IN dB
A= 10^(a/20);// open voltage gain
Beta=0.009;// feedback ratio
Af= (A/(1+(Beta*A)));//GAIN WITH FEEDBACL
AfdB= 20*(log10(Af));//gain with feedback in dB
disp(AfdB,"gain with feedback in dB is")
```

Scilab code Exa 6.27 reduction in distortion

```
// Example 6.27;// reduction in distortion
clc;
clear;
close;
a=54.8;// OPEN LOOP VOLTAGE GAIN IN dB
A= 10^(a/20);// open voltage gain
Beta=0.02;// feedback ratio
Af= (A/(1+(Beta*A)));//GAIN WITH FEEDBACL
dA= (1/(1+Beta*A))*100;//percentage change in
    distortion
disp(dA,"percentage change in distortion is")
```

Scilab code Exa 6.28 feedback and impedence

```
// Example 6.28;//gain with feedback ,input
    impedance and output impedance
clc;
clear;
close;
Zi=1;//input impedance in killo ohms
```

```
Zo=40;//input impedance in killo ohms
A=10000;//gain wtihout feedback
Beta=0.05;//gain
Afb=round(A/(1+Beta*A));//overall gain
Zif= round((1+A*Beta)*Zi);//input impedance with
    feedback in mega ohms
Zof= round(Zo*10^3/(1+Beta*A));//OUTPUT impedance
    with feedback in  ohms
disp(Afb,"overall voltage gain")
disp(Zif,"input impedance with feedback in mega ohms
    ")
disp(Zof,"OUTPUT impedance with feedback in  ohms")
```

Scilab code Exa 6.29 bandwidth

```
// Example 6.29;//bandwidth
clc;
clear;
close;
F2=16;//upper cutoff frequency in killo hertz
    without feedback
F1=40;//upper cutoff frequency in hertz without
    feedback
A= 800;// open loop voltage gain
Beta=0.02;// feedback ratio
Afb= (A/(1+(Beta*A)));//GAIN WITH FEEDBACk
F2f=F2*(1+A*Beta);//uppor cutoff frequency with
    feedback in killo hertz
F1f=F1/(1+A*Beta)*10^-3;//lower cutoff frequency
    with feedback in killo hertz
Bw=F2-F1*10^-3;///bandwidth without feedback in
    killo hertz
Bwf=round(F2f-F1f);//bandwidth with feedback in
    killo hertz
disp(Bw,"bandwidth without feedback in killo hertz")
```

```
disp(Bwf,"bandwidth with feedback in killo hertz")
```

Scilab code Exa 6.30 bandwidth

```
// Example 6.30;//bandwidth
clc;
clear;
close;
BW=10;//bandwidth without feedback in killo hertz
A= 100;// open loop voltage gain
Beta=0.1;// feedback ratio
Afb= (A/(1+(Beta*A)));//GAIN WITH FEEDBACk
Bwf=round(BW*(1+Beta*A));//bandwidth with feedback
    in killo hertz
disp(Afb,"feedback gain")
disp(Bwf,"bandwidth with feedback in killo hertz")
```

Scilab code Exa 6.31 gain and harmonic distortion

```
// Example 6.31;//gain and harmonic distortion
clc;
clear;
close;
A2= 200;// open loop voltage gain
Beta=0.1;// feedback ratio
D2=0.02;//first stage distortion
D2d= (D2/(1+Beta*A2))*100;//second stage distortion
A2d=A2/(1+Beta*A2);//GAIN
A1=round(A2/A2d);//gain of first stage
disp(A1,"gain of first stage is")
disp(D2d,"second stage distortion is")
disp("second stage distortion is calculated wrong in
    the book")
```

Scilab code Exa 6.32 pole frequency

```
// Example 6.32;pole frequency
clc;
clear;
close;
R2=2*10^5;//effective resistance in ohms
Av2=1000;//gain of second stage
Cf=20;//feedback capacitor in pico farad
Cm=(1+Av2)*Cf;//effective miller capacitance in pico
    farad
fp1= 1/(2*%pi*R2*Cm*10^-12);//pole frequency in
    hertz
disp(fp1,"pole frequency in hertz is")
```

Chapter 7

OSCILLATORS

Scilab code Exa 7.1 oscillation frequency

```
// Example 7.1:oscillation frequency
clc;
clear;
close;
c=450;//capacitance of tunned circuit in pico farad
L=29.3;//INDUCTANCE of tunned circuit in micro henry
fo=(1/(2*%pi*sqrt(L*10^-6*c*10^-12)))*10^-6;//tunned
    frequency in mega hertz
disp(fo,"tunned frequency in mega hertz is")
```

Scilab code Exa 7.2 tunned capacitance range of tunned circuit

```
// Example 7.2:tunned capacitance range of tunned
   circuit
clc;
clear;
close;
L=100;//INDUCTANCE of tunned circuit in micro henry
```

```
fo1=500;//tunned frequency in killo hertz
fo2=1500;//tunned frequency in killo hertz
C1= (1/(4*%pi^2*(fo1*10^-6)^2*L*10^-6))*10^-6;//
    tunned capacitance
C2= (1/(4*%pi^2*(fo2*10^-6)^2*L*10^-6))*10^-6;//
    tunned capacitance
disp(C1,"-",C2,"tunned capacitance range of tunned
    circuit IN PICO FARAD IS")
```

Scilab code Exa 7.3 TRANSFORMER WINDING RATIO

```
// Example 7.3:TRANSFORMER WINDING RATIO
clc;
clear;
close;
Vcc=12;//collector vltage
Po=88;//power output in milli watt
Ploss=8;//power losses in milli watt
Pi= Po+Ploss;//input power in milli watt
Ic= Pi/Vcc;//collector current in milli ampere
gm=10;//transconductance in milli ampere per volt
Vb= Ic/(gm);//base VOLTAGE
TR=Vcc/Vb;//transfomer turn ratio
disp(TR,"transformer turn ratio is")
```

Scilab code Exa 7.4 oscillation frequency

```
// Example 7.4:oscillation frequency
clc;
clear;
close;
C1=0.005;//capacitance of tunned circuit in micro
    farad
```

```
C2=0.01;//capacitance of tunned circuit in micro farad
C=(C1*C2)/(C1+C2);//total capacitance in micro farad
L=100;//INDUCTANCE of tunned circuit in micro henry
fo=(1/(2*%pi*sqrt(L*10^-6*C*10^-6)))*10^-3;//tunned frequency in killo hertz
disp(fo,"tunned frequency in killo hertz is")
```

Scilab code Exa 7.5 oscillation frequency

```
// Example 7.5:oscillation frequency
clc;
clear;
close;
C1=500;//capacitance of tunned circuit in PICO farad
C2=500;//capacitance of tunned circuit in pico farad
C=(C1*C2)/(C1+C2);//total capacitance in micro farad
L=1;//INDUCTANCE of tunned circuit in milli henry
fo=(1/(2*%pi*sqrt(L*10^-3*C*10^-12)))*10^-3;//tunned frequency in killo hertz
disp(fo,"tunned frequency in killo hertz is")
```

Scilab code Exa 7.6 tunned capacitance and inductance of tunned circuit

```
// Example 7.6:tunned capacitance and inductance of tunned circuit
clc;
clear;
close;
fo=500;//tunned frequency in killo hertz
LC= (1/(4*%pi^2*(fo*10^-3)^2));//
L3=1;//assume inductance
C=LC/(L3*10^-3);//capacitance in pico farad
```

```
C1= 2*C;//
C2=C1;
disp(L3,"inductance in milli henry is")
disp(C1,"tunned capacitance C1 of tunned circuit IN
   PICO FARAD IS")
disp(C2,"tunned capacitance C2 of tunned circuit IN
   PICO FARAD IS")
```

Scilab code Exa 7.7 minimum gain and emitter resistance

```
// Example 7.6:operating frequency ,feedback fration
    ,minimum gain and emitter resistance
clc;
clear;
close;
Rc=2.5;//collector resistance in killo ohms
C1=0.001;//capacitance of tunned circuit in micro
   farad
C2=0.01;//capacitance of tunned circuit in micro
   farad
L=100;//INDUCTANCE of tunned circuit in micro henry
C=(C1*C2)/(C1+C2);//total capacitance in micro farad
fo=round((1/(2*%pi*sqrt(L*10^-6*C*10^-6)))*10^-3);//
   tunned frequency in killo hertz
Beta=C1/C2;//feedback fration
Amin= 1/Beta;//gain
Re= Rc*10^3/Amin;//emitter resistance in ohms
disp(fo,"tunned frequency in killo hertz")
disp(Beta,"feedback fraction is")
disp(Amin,"minimum gain is")
disp(Re,"emitter resistance in ohms")
```

Scilab code Exa 7.8 tunned capacitance

```
// Example 7.8:tunned capacitance  of tunned circuit
clc;
clear;
close;
fo1=50;//tunned frequency in killo hertz
L1=100;//inductance in micro henry
L2=100;//inductance in micro henry
C= (1/(4*%pi^2*(fo1*10^-6)^2*(L1+L2)*10^-6))*10^-12;
    //tunned capacitance
disp(C,"tunned capacitance  tunned circuit IN MICRO
    FARAD IS")
```

Scilab code Exa 7.9 oscillation frequency

```
// Example 7.9:oscillation frequency
clc;
clear;
close;
C=0.2;//capacitance of tunned circuit in MICRO farad
L1=0.5;//INDUCTANCE of tunned circuit in milli henry
L2=1;//INDUCTANCE of tunned circuit in milli henry
fo=(1/(2*%pi*sqrt((L1+L2)*10^-3*C*10^-6)));//tunned
    frequency in killo hertz
disp(fo,"tunned frequency in killo hertz is")
```

Scilab code Exa 7.10 oscillation frequency

```
// Example 7.10:oscillation frequency
clc;
clear;
close;
C=100;//capacitance of tunned circuit in pico farad
L1=1;//INDUCTANCE of tunned circuit in milli henry
```

```
L2=0.1;//INDUCTANCE of tunned circuit in milli henry
fo=(1/(2*%pi*sqrt((L1+L2)*10^-3*C*10^-12)))*10^-3;//
    tunned frequency in killo hertz
disp(fo,"tunned frequency in killo hertz is")
```

Scilab code Exa 7.11 feedback ratio

```
// Example 7.11:feedback ratio
clc;
clear;
close;
Af=40;//gain wtih feedback
Vi=2.4;//input voltage
Vif=0.1;//input voltage with feedback
A= Af*(Vi/Vif);//gain without feedback
Beta= (1-(A/Af))/A;//feedback ratio
disp(Beta,"feedback ratio is")
```

Scilab code Exa 7.12 resonant frequency

```
// Example 7.12:resonant frequency
clc;
clear;
close;
Cs=0.08;//capacitance of tunned circuit in pico
    farad
Ls=0.8;//series INDUCTANCE of tunned circuit in
    henry
Cp=1;//parallel capacitance in pico farad
Rs=5;//SERIES RESISTANCE IN KILLO OHMS
fs=round((1/(2*%pi*sqrt(Ls*Cs*10^-12)))*10^-3);//
    series tunned frequency in killo hertz
```

```
fp=round(((1/(2*%pi))*sqrt((1+Cs/Cp)/(Ls*Cs*10^-12)))*10^-3);//parralel tunned frequency in killo hertz
disp(fs,"series tunned frequency in killo hertz is")
disp(fp,"parallel tunned frequency in killo hertz is")
```

Scilab code Exa 7.13 quality factor

```
// Example 7.12:quality factor
clc;
clear;
close;
f=450;//resonant frequency in killo hertz
L=4.2;//inductnace in henry
R=600;//resistance in ohms
Q= round((2*%pi*f*10^3*L)/R);//quality factor
disp(Q,"quality factor is")
```

Scilab code Exa 7.14 resonant frequency

```
// Example 7.14:resonant frequency
clc;
clear;
close;
Cs=0.01;//capacitance of tunned circuit in pico farad
Ls=0.8;//series INDUCTANCE of tunned circuit in henry
Cp=20;//parallel capacitance in pico farad
Rs=5;//SERIES RESISTANCE IN KILLO OHMS
fs=((1/(2*%pi*sqrt(Ls*Cs*10^-12)))*10^-3);//series tunned frequency in killo hertz
```

```
fp=(((1/(2*%pi))*sqrt((1+Cs/Cp)/(Ls*Cs*10^-12)))*10^-3);//parralel tunned frequency in killo hertz
disp(fs,"series tunned frequency in killo hertz is")
disp(fp,"parallel tunned frequency in killo hertz is")
```

Scilab code Exa 7.15 percentage change and quality factor

```
// Example 7.15:resonant frequency,percentage change and quality factor
clc;
clear;
close;
Cs=0.065;//capacitance of tunned circuit in pico farad
Ls=0.33;//series INDUCTANCE of tunned circuit in henry
Cp=1;//parallel capacitance in pico farad
Rs=5.5;//SERIES RESISTANCE IN KILLO OHMS
fs=round((1/(2*%pi*sqrt(Ls*Cs*10^-12)))*10^-3);//series tunned frequency in killo hertz
fp=round(((1/(2*%pi))*sqrt((1+Cs/Cp)/(Ls*Cs*10^-12)))*10^-3);//parralel tunned frequency in killo hertz
Pc= ((fp-fs)/fs)*100;//percentage by which series resonant frequency exceeds the parallel resonant frequency
Qs= round((2*%pi*fs*10^3*Ls)/(Rs*10^3));//quality factor with series resonant frequency
Qp= round((2*%pi*fp*10^3*Ls)/(Rs*10^3));//quality factor with parallled resonant frequency
disp(fs,"series tunned frequency in killo hertz is")
disp(fp,"parallel tunned frequency in killo hertz is")
```

```
disp(Pc,"percentage by which series resonant frequency exceeds the parallel resonant frequency")
disp(Qs,"quality factor with series resonant frequency is")
disp(Qp,"quality factor with paralled resonant frequency is")
```

Scilab code Exa 7.16 oscillation frequency

```
// Example 7.16:oscillation frequency
clc;
clear;
close;
C1=120;//capacitance of tunned circuit in PICO farad
C2=1500;//capacitance of tunned circuit in pico farad
C3=15;//capacitance of tunned circuit in pico farad
Cx=(C1*C2)/(C1+C2);//capacitance in pico farad
Ct=(Cx*C3)/(Cx+C3);//total capacitance in pico farad
L=10;//INDUCTANCE of tunned circuit in micro henry
fo=(1/(2*%pi*sqrt(L*10^-6*Ct*10^-12)))*10^-6;//tunned frequency in mega hertz
foa= (1/(2*%pi*sqrt(L*10^-6*C3*10^-12)))*10^-6;//actual resonant frequency in mega hertz
disp(fo,"tunned frequency in killo mega is")
disp(foa,"actual resonant frequency in mega hertz")
```

Scilab code Exa 7.17 resonant frequency

```
// Example 7.16:resonant frequency
clc;
clear;
```

```
close;
R=500;//resistance in ohms
C1=0.01;//capacitance of tunned circuit in pico farad
C2=10;//capacitance of tunned circuit in pico farad
C=(C1*C2)/(C1+C2);//total capacitance in micro farad
L=0.06;//INDUCTANCE of tunned circuit in  henry
fs=((1/(2*%pi*sqrt(L*C1*10^-12)))*10^-6);//series tunned frequency in mega hertz
C=(C1*C2)/(C1+C2);//total capacitance in pico farad
fp=(1/(2*%pi*sqrt(L*C*10^-12))*10^-6);//parralel tunned frequency in mega hertz
disp(fs,"series tunned frequency in mega hertz is")
disp(fp,"parallel tunned frequency in mega hertz is")
```

Scilab code Exa 7.18 oscillation frequency

```
// Example 7.18:oscillation frequency
clc;
clear;
close;
C=100;//capacitance of tunned circuit in pico farad
L1=50;//INDUCTANCE of tunned circuit in micro henry
L2=50;//INDUCTANCE of tunned circuit in micro henry
fo=(1/(2*%pi*sqrt((L1+L2)*10^-6*C*10^-12)))*10^-6;//tunned frequency in mega hertz
disp(fo,"tunned frequency in mega hertz is")
```

Scilab code Exa 7.19 scillation frequency

```
// Example 7.19:oscillation frequency
clc;
```

```
clear;
close;
C1=120;//capacitance of tunned circuit in PICO farad
C2=1500;//capacitance of tunned circuit in pico
   farad
C=(C1*C2)/(C1+C2);//total capacitance in pico farad
L=10;//INDUCTANCE of tunned circuit in micro henry
fo=(1/(2*%pi*sqrt(L*10^-6*C*10^-12)))*10^-6;//tunned
    frequency in mega hertz
disp(fo,"tunned frequency in mega hertz is")
```

Scilab code Exa 7.20 oscillation frequency

```
// Example 7.20:oscillation frequency
clc;
clear;
close;
C1=120;//capacitance of tunned circuit in PICO farad
C2=1500;//capacitance of tunned circuit in pico
   farad
C3=15;//capacitance of tunned circuit in pico farad
Cx=(C1*C2)/(C1+C2);//capacitance in pico farad
Ct=(Cx*C3)/(Cx+C3);//total capacitance in pico farad
L=10;//INDUCTANCE of tunned circuit in micro henry
fo=(1/(2*%pi*sqrt(L*10^-6*Ct*10^-12)))*10^-6;//
   tunned frequency in mega hertz
disp(fo,"tunned frequency in killo mega is")
```

Scilab code Exa 7.21 oscillation frequency

```
// Example 7.21:oscillation frequency
clc;
clear;
```

```
close;
C=100;//capacitance in pico farad
R=800;//resistance in killo ohms
fo=round(1/(2*%pi*R*10^3*C*10^-12*sqrt(6)));//
   RESONANT FREQUENCY IN HERTZ
disp(fo,"RESONANT FREQUENCY IN HERTZ")
```

Scilab code Exa 7.22 oscillation frequency

```
// Example 7.22:oscillation frequency
clc;
clear;
close;
w=2*10^3;//in radiand per second
f= round(w/(2*%pi));//resonant frequency
X=(((16*10^9*4*w^2*10^3))/((4*w^2*10^3)^2));//
disp(f,"resonant frequency in hertz")
disp(X,"oscillations are sustained")
```

Scilab code Exa 7.23 Design R C phase shift oscillator

```
// Example 7.23:Design R-C phase shift oscillator
clc;
clear;
close;
fo=1;//resonant frequency in killo hertz
Av= 29;//voltage gain
Vcc=10;//collector voltage
Ib=0.5;//maximum base current in micro ampere
I1=100*Ib;//assume current in micro ampere
Vosat= 0.9*Vcc;//saturation voltage assume
V1=Vosat/Av;//voltage for sustained oscillations
R1=(V1/(I1*10^-6))*10^-3;//RESISTANCE IN KILLO PHMS
```

```
Rf1=Av*R1;//resistance in killo ohms
Rf2=180;//standard resistance in killo ohms
R3=Rf2;//
R=R1;//
C=(1/(2*%pi*R*10^3*fo*10^3*sqrt(6)))*10^6;//
    capacitance in micro farad
disp(R,"Resistance for the R–C Phase shift
    oscillator in kilo ohms is")
disp(R3,"Resistance for the R–C Phase shift
    oscillator in kilo ohms is")
disp(C,"Capacitance for the R–C Phase shift
    oscillator in micro−farad is")
```

Scilab code Exa 7.24 Design R C phase shift oscillator

```
// Example 7.24:drain resistance and Design R–C
    phase shift oscillator
clc;
clear;
close;
Mu=55;//
rd=5.5;//resistane in killo ohms
fo=5;//resonant frequency in killo hertz
A= 29;//voltage gain
Rd= (29*rd)/(Mu-A);//resistance in killo ohms
RC=round((1/(2*%pi*fo*10^3*sqrt(6)))*10^6);//R–C in
    pico second
R=30;;//assume Resistance in killo ohms
C=round(RC*10^-6/(30*10^3)*10^12);//CAPACITANCE IN
    PICO FARAD
disp(Rd,"drain resistance in killo ohms is")
disp(RC,"R–C in pico second")
disp(C,"Capacitance for the R–C Phase shift
    oscillator in PICO−farad is")
```

Scilab code Exa 7.25 oscillations and mimimum gain

```
// Example 7.25:Vf/Vo,frequency of oscillations and
   mimimum gain
clc;
clear;
close;
Beta=1/29;//GAIN
VfVo= (Beta+1);//
disp(VfVo,"Voltage gain is")
disp("f=1/(2*%pi*R*C*sqrt(6)) frequency of
   oscillations")
disp("AS gain is more than one oscillations will be
   sustained")
```

Scilab code Exa 7.26 design wein bridge oscillator

```
// Example 7.26:design wein bridge oscillator
clc;
clear;
close;
Vcc=15;//collector voltage
f=10;//frequency of oscillation in killo hertz
Vo=Vcc-1;//maximum output voltage
I=1;//current in millo ampere
x=Vo/I;//resistance in killo ohms
R4=x/3;//resistance in killo ohms
R3= 2*R4;//resistance in killo ohms
A= round(1+(R3/R4));//amplifier gain
R=R4;//resistance in killo ohms
C=(1/(2*%pi*f*10^3*R*10^3))*10^9;//CAPACITANCE IN
   NANO FARAD
```

```
disp(A,"amlifier gain is")
disp(R,"resistance in killo ohms")
disp(R3,"resistance in killo ohms")
disp(C,"CAPACITANCE IN NANO FARAD")
disp("this is name as example 7.27 in the book" )
```

Scilab code Exa 7.27 oscillations and output frequency

```
// Example 7.27:sustained oscillations and output frequency
clc;
clear;
close;
R4=5.1;//resistance in killo ohms
R3=12;//resistance in killo ohms
A= round(1+(R3/R4));//amplifier gain
R=R4;//resistance in killo ohms
C=1;//capacitance in nano farad
fo= (1/(2*%pi*C*10^-9*R*10^3))*10^-3;//FREQUENCY OF OSCILLATION IN KILLO HERTZ
disp(A,"amlifier gain is it is greater than 1 so circuit will oscillate")
disp(fo,"oscillation frequency in killo hertz")
```

Scilab code Exa 7.29 design wein bridge oscillator

```
// Example 7.28:design wein bridge oscillator
clc;
clear;
close;
Vcc=10;//collector voltage
f=10;//frequency of oscillation in killo hertz
Vo=Vcc-1;//maximum output voltage
```

```
I=500;//current in micro ampere
x=(Vo/I)*10^3;//resistance in killo ohms
R4=x/3;//resistance in killo ohms
R3= 2*R4;//resistance in killo ohms
R=R4;//resistance in killo ohms
C=(1/(2*%pi*f*10^3*R*10^3))*10^12;//CAPACITANCE IN
    pico FARAD
disp(R,"resistance in killo ohms")
disp(R3,"resistance in killo ohms")
disp(C,"CAPACITANCE IN NANO FARAD")
```

Scilab code Exa 7.32 design BJT R C Phase shift oscillator

```
// Example 7.33:Design R-C phase shift oscillator
clc;
clear;
close;
Vce=5;//in volts
RE=1;//emitter reistsance in killo ohms
Vbe=0.7;//in volts
Ie=1;//emitter current in mA
Re=1;//EMITTER RESISTANCE IN KILLO OHMS
f=100;//oscillaor frequency in killo hertz
hfe=100;//
hie=1;//in killo ohms
Vc=5;//in volts
Ic=1;//current in mili ampere
Vcc=20;//in volts
R=10;//resistane in killo ohms
Rc= ((Vcc-Vce-Ie*Re)/(Ic));//collector resistance in
     killo ohms is
k= Rc/R;
C= ((1/(2*%pi*R*10^3*f*10^3*sqrt(6+(4*1.4)))))
    *10^12;//capacitance in pico farad
R3= R-hie;//resistance in kiilo ohms
```

```
Vb= (Vbe+Ie*Re);//voltage at base
R2=R;//
I2=Vb/R2;// in mA
V2=(Vcc-R2*I2);//voltage drop across R2
IR1= (I2+(1/100));//CURRENT ACROOS R1
R1= V2/(IR1);//
disp(Re,"Emitter resistance in killo ohms is")
disp(Rc,"collector resistance in killo ohms is")
disp(R," resistance in killo ohms is")
disp(C,"Capacitance in pico farad is")
disp(R3," resistance(R3) in killo ohms is")
disp(R2," resistance(R2) in killo ohms is")
disp(R1," resistance(R1) in killo ohms is")
```

Scilab code Exa 7.33 design phase shift oscillator

```
// Example 7.33:Design R-C phase shift oscillator
clc;
clear;
close;
rd=40;//resistane in killo ohms
fo=1//resonant frequency in killo hertz
gm= 5000;//in killo mh
R=10;;//assume Resistance in killo ohms
C=((1/(2*%pi*fo*10^3*R*10^3*sqrt(6)))*10^9);//C in
    nano farad
Av=29;//VOLTAGE GAIN
Vdd=12;//drain voltage
Rl= (Av/gm*10^-6)*10^9;//load resistance in killo
    ohms
Rd= ((Rl*rd)/(rd-Rl));//drain resistance in killo
    ohms
disp(Rd,"drain resistance in killo ohms is")
disp(C,"Capacitance for the R-C Phase shift
    oscillator in NANO-farad is")
```

Scilab code Exa 7.34 components of wein bridge oscialltor

```
// Example 7.32:design wein bridge oscillator
clc;
clear;
close;
R=100;//ASSUME RESSITANCE IN KILO OHMS
fo1=10;//tunned frequency in killo hertz
fo2=100;//tunned frequency in  hertz
C1= (1/(2*%pi*R*10^3*fo1*10^3))*10^9;//tunned
   capacitance
C2= (1/(2*%pi*R*10^3*fo2))*10^9;//tunned capacitance
disp(C1,"tunned capacitance range of tunned circuit
   IN NANO FARAD IS")
disp(C2,"tunned capacitance range of tunned circuit
   IN NANO FARAD IS")
```

Scilab code Exa 7.35 series and parallel resonant frequencies

```
// Example 7.33:resonant frequency and quality
   factor
clc;
clear;
close;
Cs=0.06;//capacitance of tunned circuit in pico
   farad
Ls=0.5;//series INDUCTANCE of tunned circuit in
   henry
Cp=1;//parallel capacitance in pico farad
Rs=5;//SERIES RESISTANCE IN KILLO OHMS
fs=round((1/(2*%pi*sqrt(Ls*Cs*10^-12)))*10^-3);//
   series tunned frequency in killo hertz
```

```
fp=round(((1/(2*%pi))*sqrt((1+Cs/Cp)/(Ls*Cs*10^-12)))*10^-3);//parralel tunned frequency in killo hertz
Pc= ((fp-fs)/fs)*100;//percentage by which series resonant frequency exceeds the parallel resonant frequency
Qs= round((2*%pi*fs*10^3*Ls)/(Rs*10^3));//quality factor with series resonant frequency
Qp= round((2*%pi*fp*10^3*Ls)/(Rs*10^3));//quality factor with paralllled resonant frequency
disp(fs,"series tunned frequency in killo hertz is")
disp(fp,"parallel tunned frequency in killo hertz is")
disp(Qs,"quality factor with series resonant frequency is")
disp(Qp,"quality factor with paralled resonant frequency is")
```