

Scilab Textbook Companion for
Solid State Devices And Circuits
by S. Sharma¹

Created by
Nitin Kumar
B.TECH
Electronics Engineering
Uttarakhand Technical Univeristy
College Teacher
Arshad Khan
Cross-Checked by
Mukul Kulkarni

July 31, 2019

¹Funded 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	4
1 Special diodes	5
2 Bipolar Junction Transistors	10
3 TRANSISTOR AMPLIFIERS	59
4 FIELD EFFECT TRANSISTORS AND MOSFETs	69
5 FREQUENCY RESPONSE	77
6 FEEDBACK	99
7 OSCILLATORS	118

List of Scilab Codes

Exa 1.1	resistance	5
Exa 1.2	terminal voltage	5
Exa 1.3	tunning range	6
Exa 1.4	resistance	6
Exa 1.5	LED Current	6
Exa 1.6	supply voltage	7
Exa 1.7.a	photocurrent	8
Exa 1.7.b	photocurrent	8
Exa 1.8	quantum efficiency	8
Exa 1.9	responsivity	9
Exa 2.1	Common base d c current	10
Exa 2.2	base current	10
Exa 2.3	collector current and base current	11
Exa 2.4	collector and base current	11
Exa 2.5.a	dc current gain	11
Exa 2.5.b	ac current gain	12
Exa 2.6	collector and base current	12
Exa 2.7	dc load line	12
Exa 2.8.a	operating point	13
Exa 2.8.b	stability factor	13
Exa 2.9.a	base current	13
Exa 2.9.b	collector current	14
Exa 2.9.c	collector to emitter voltage	14
Exa 2.9.d	stability factor	15
Exa 2.10.a	ground and stability factor	15
Exa 2.11	DC Bias voltages and currents	15
Exa 2.12	collector current collector to emitter voltage and stability factor	16

Exa 2.13	colector current collector to emitter voltage and stability factor	16
Exa 2.14	base current collector current and stability factor	17
Exa 2.15	emitter current collector current and collector to emitter voltage	17
Exa 2.16	change in q point	18
Exa 2.17	input resistance	19
Exa 2.18	base current collector current and collector to emitter voltage	19
Exa 2.19	operating point and stability factor	20
Exa 2.20	resistance and stability factor	21
Exa 2.21	quiescent point and stability factor	21
Exa 2.22	Collector to emitter bias voltage	22
Exa 2.23	base and collector resistance	22
Exa 2.24	resistance and stability factor	23
Exa 2.25	operating point and stability factor	23
Exa 2.26	resistance	24
Exa 2.27	resistance	25
Exa 2.28	collector current and collector to emitter voltage	25
Exa 2.29	voltage	26
Exa 2.30	Collector resistance	26
Exa 2.31	collector voltage and emitter resistor	27
Exa 2.32	Beta collecor voltage and base resistance	28
Exa 2.33	change in emitter to collector voltage	28
Exa 2.34	base current	29
Exa 2.35	base current collector current and collector to emitter voltage	29
Exa 2.36	resistance and stability factor	30
Exa 2.37.a	Biasing components	31
Exa 2.37.b	biasing components	31
Exa 2.38.a	stability factor	32
Exa 2.38.b	stability factor	32
Exa 2.39.a	change in collector current	33
Exa 2.39.b	change in collector current	33
Exa 2.40	resistance	34
Exa 2.41	resistance and stability factor	35

Exa 2.42	quiescent current	35
Exa 2.43	quiescent currents	36
Exa 2.44.a	resistance	38
Exa 2.44.b	resistance	38
Exa 2.45	resistance	39
Exa 2.46	resistance	40
Exa 2.47	current gain input resistance and voltage gain	41
Exa 2.48	current gain input resistance and voltage gain	42
Exa 2.49	current gain input resistance and voltage gain	42
Exa 2.50	current gain input resistance voltage gain and output resistance	43
Exa 2.51	current gain input resistance and voltage gain	44
Exa 2.52	current gain input resistance and voltage gain	45
Exa 2.53	current gain input resistance voltage gain and power gain	45
Exa 2.54.a	quiescent point	46
Exa 2.54.b	voltage gain and input resistance	47
Exa 2.55	resistive parameters	48
Exa 2.56	resistive parameters	49
Exa 2.57	cut off frequencies	49
Exa 2.58	resistive parameters	50
Exa 2.59	h parameters and hybrid parameters	50
Exa 2.60	hybrid model parameters	51
Exa 2.61	hybrid parameters	52
Exa 2.62	mid band voltage gain and upper 3 db cut off frequency	53
Exa 2.63	mid band voltage gain and upper 3 db cut off frequency	54
Exa 2.64	resonant frequency and voltage drop	54
Exa 2.65	resonant frequency impedance q factor band- width and line current	55
Exa 2.66	resonant frequency impedance q factor and band- width	56
Exa 2.67	Q FACTOR	56
Exa 2.68	Q FACTOR	57
Exa 2.69	PARALLEL IMPEDENCE	57
Exa 3.1	input impedance output impedance and cur- rent gain	59

Exa 3.2	input impedance output impedance and current gain	60
Exa 3.3	input impedance output impedance and current gain	61
Exa 3.4	collector efficiency	62
Exa 3.5	maximum power output	62
Exa 3.6	power rating of transistor	63
Exa 3.7	power dissipated and efficiency	63
Exa 3.8	overall efficiency	65
Exa 3.9.a	harmonic distortion	65
Exa 3.9.b	harmonic distortion	65
Exa 3.10	harmonic distortion and percentage	66
Exa 3.11.a	minimum power drain	67
Exa 3.11.b	minimum average power dissipation	67
Exa 3.12	power and conversion efficiency	68
Exa 4.1	drain current	69
Exa 4.2	drain current	69
Exa 4.3	minimum and maximum transconductance curve	70
Exa 4.4	drain current and transconductance	71
Exa 4.5	drain resistance	71
Exa 4.6	drain resistance	72
Exa 4.7	drain to source resistance	72
Exa 4.8	circuit analyze	73
Exa 4.9	drain resistance	73
Exa 4.10	channel width to channel length ratio and drain resistance	74
Exa 4.11	drain to source resistance	75
Exa 4.12	input resistance	75
Exa 5.1	coupling capacitor	77
Exa 5.2	amplifier gain	77
Exa 5.3	amplifier gain	78
Exa 5.4	amplifier gain	78
Exa 5.5	maximum voltage gain	79
Exa 5.6	series capacitance and transfer function . . .	79
Exa 5.7	corner frequency and maximum magnitude asymptote	80
Exa 5.8	frequency and bandwidth	80
Exa 5.9	frequency and bandwidth	81

Exa 5.10	CORNER FREQUENCIES AND BANDWIDTH	82
Exa 5.11	LOW FREQUENCY RESPOANSE	82
Exa 5.12	CORNER FREQUENCY AND MAXIMUM GAIN	83
Exa 5.16	OPEN CIRCUIT AND SHORT CIRCUIT TIME CONSTANTS VOLTAGE GAIN	84
Exa 5.17	LOW FREQUENCY RESPONSE	85
Exa 5.18	fB	86
Exa 5.19	BANDWIDTH AND CAPACITANCE	86
Exa 5.20	3 DB FREQUENCY RESPONSE	87
Exa 5.21	MIDBAND GAIN AND UPPER 3DB FRE- QUENCY	88
Exa 5.22	MIDBAND GAIN AND UPPER 3DB FRE- QUENCY	89
Exa 5.23	MIDBAND GAIN AND UPPER 3DB FRE- QUENCY	90
Exa 5.24	UPPER AND LOWER CUT OFF FREQUENCY	91
Exa 5.25	PERCENTAGE TILT	92
Exa 5.26	PERCENTAGE TILT AND LOWEST INPUT FREQUENCY	92
Exa 5.27	LOWER AND UPPER CUT OFF FREQUENCY	93
Exa 5.28	OVERALL BANDWIDTH	93
Exa 5.29	UPPER AND LOWER CUT OFF FREQUENCY	94
Exa 5.30	VOLTAGE GAIN UPPER CUT OFF FRE- QUENCY AND COUPLING CAPACITOR	94
Exa 5.31	GAIN OF OVERALL AMPLIFIER	95
Exa 5.32	OVERALL VOLTAGE GAIN LOWER CUT OFF FREQUENCY AND UPPER CUT OFF FREQUENCY	96
Exa 5.33	MIDBAND VOLTAGE GAIN CUT OFF FRE- QUENCIES	97
Exa 6.1	gain	99
Exa 6.2	feedback factor	99
Exa 6.3	feedback output	100
Exa 6.4	feedback ratio	100
Exa 6.5	Change in gain	101
Exa 6.6	open loop voltage gain	101
Exa 6.7	open loop voltage gain and negaive feedback	101

Exa 6.8	INPUT VOLTAGE AND OUTPUT VOLTAGE	102
Exa 6.9	distortion AND close loop gain	103
Exa 6.10	input and output impedance	103
Exa 6.11	feedback factor and Change in gain	104
Exa 6.12	gain and frequency	105
Exa 6.13	feedback factor and bandwidth	105
Exa 6.14	voltage gain and input and output resistance	106
Exa 6.15	INPUT IMPEDANCE	106
Exa 6.16	gain	107
Exa 6.17	gain	108
Exa 6.18	voltage gain and resistance	108
Exa 6.19	loop gain	109
Exa 6.20	voltage gain	110
Exa 6.21	change in overall gain	110
Exa 6.22	input impedance with feedback	111
Exa 6.23	feedback factor and change in overall gain .	111
Exa 6.24	feedback fraction overall voltage gain and output voltage	112
Exa 6.25	overall gain and impedance	113
Exa 6.26	gain	113
Exa 6.27	reduction in distortion	114
Exa 6.28	feedback and impedance	114
Exa 6.29	bandwidth	115
Exa 6.30	bandwidth	116
Exa 6.31	gain and harmonic distortion	116
Exa 6.32	pole frequency	117
Exa 7.1	oscillation frequency	118
Exa 7.2	tuned capacitance range of tuned circuit .	118
Exa 7.3	TRANSFORMER WINDING RATIO	119
Exa 7.4	oscillation frequency	119
Exa 7.5	oscillation frequency	120
Exa 7.6	tuned capacitance and inductance of tuned circuit	120
Exa 7.7	minimum gain and emitter resistance	121
Exa 7.8	tuned capacitance	121
Exa 7.9	oscillation frequency	122
Exa 7.10	oscillation frequency	122

Exa 7.11	feedback ratio	123
Exa 7.12	resonant frequency	123
Exa 7.13	quality factor	124
Exa 7.14	resonant frequency	124
Exa 7.15	percentage change and quality factor	125
Exa 7.16	oscillation frequency	126
Exa 7.17	resonant frequency	126
Exa 7.18	oscillation frequency	127
Exa 7.19	oscillation frequency	127
Exa 7.20	oscillation frequency	128
Exa 7.21	oscillation frequency	128
Exa 7.22	oscillation frequency	129
Exa 7.23	Design R C phase shift oscillator	129
Exa 7.24	Design R C phase shift oscillator	130
Exa 7.25	oscillations and minimum gain	131
Exa 7.26	design wein bridge oscillator	131
Exa 7.27	oscillations and output frequency	132
Exa 7.29	design wein bridge oscillator	132
Exa 7.32	design BJT R C Phase shift oscillator	133
Exa 7.33	design phase shift oscillator	134
Exa 7.34	components of wein bridge oscillator	135
Exa 7.35	series and parallel resonant frequencies	135

Chapter 1

Special diodes

Scilab code Exa 1.1 resistance

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

Scilab code Exa 1.2 terminal voltage

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

Scilab code Exa 1.3 tuning range

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

Scilab code Exa 1.4 resistance

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

Scilab code Exa 1.5 LED Current

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

```

2 clc, clear
3 v1=1.5; // in volts
4 v2=2.3; // in volts
5 vs=10; // in volts
6 r1=470; // in ohm
7 I1=(vs-v1)/r1; // in ampere
8 I2=(vs-v2)/r1; // in ampere
9 disp(I1,"maximum current in ampere (A) = ")
10 disp(I2,"minimum current in ampere (A) = ")

```

Scilab code Exa 1.6 supply voltage

```

1 // Example 1.6: which supply voltage will keep
  brightness of diode constant
2 clc, clear
3 v1=1.8; // in volts
4 v2=3; // in volts
5 vs=24; // in volts
6 rs=820; // in ohms
7 Imin=((vs-v2)/rs); // case1
8 Imax=((vs-v1)/rs);
9 vs1=5; // in volts
10 rs1=120; // in ohms
11 Imin1=((vs1-v2)/rs1); // case2
12 Imax1=((vs1-v1)/rs1);
13 r1=470; // in ohm I1=(vs-v1)/r1; // in ampere
14 disp(Imax,"maximum current in ampere in case1(A) = "
  )
15 disp(Imin,"minimum current in ampere in case1(A) = "
  )
16 disp(Imax1,"maximum current in ampere in case2(A) = "
  ")
17 disp(Imin1,"minimum current in ampere in case2(A) = "
  ")
18 disp("Brightness in the first case will remain

```

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

Scilab code Exa 1.7.a photocurrent

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

Scilab code Exa 1.7.b photocurrent

```
1 // Example 1.7.b : photocurrent
2 clc, clear
3 r=0.85; // reponsivity of a photodiode in amperes per
      watt
4 p1=2; // incident light power in milli watt
5 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

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

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

Scilab code Exa 1.9 responsivity

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

Chapter 2

Bipolar Junction Transistors

Scilab code Exa 2.1 Common base d c current

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

Scilab code Exa 2.2 base current

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

Scilab code Exa 2.3 collector current and base current

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

Scilab code Exa 2.4 collector and base current

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

Scilab code Exa 2.5.a dc current gain

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

Scilab code Exa 2.5.b ac current gain

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

Scilab code Exa 2.6 collector and base current

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

Scilab code Exa 2.7 dc load line

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

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

Scilab code Exa 2.8.a operating point

```
1 // Example 2.8.A: Calculate operating point
2 Vcc=6; // Collector voltage in volts
3 Rb= 530; // in kilo ohms
4 Beta=100; // Common emitter D.C. Current gain
5 Rc=2; // Collector resistance in kilo ohms
6 Vbe= 0.7; // Base to emitter voltage in volts
7 Ib= ((Vcc-Vbe)/Rb); // in micro amperes
8 Ic=Beta*Ib; // in milli ampere
9 Vce= Vcc-(Ic*Rc); // Collector to emitter voltage in
   volts
10 disp ("Operating point is (Vce,Ic)")
11 disp(Vce,"In Volts")
12 disp(Ic,"in mA")
```

Scilab code Exa 2.8.b stability factor

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

Scilab code Exa 2.9.a base current

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

```

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

```

Scilab code Exa 2.9.b collector current

```

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

```

Scilab code Exa 2.9.c collector to emitter voltage

```

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

```

Scilab code Exa 2.9.d stability factor

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

Scilab code Exa 2.10.a ground and stability factor

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

Scilab code Exa 2.11 DC Bias voltages and currents

```

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

```

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

```

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

```

Scilab code Exa 2.13 collector current collector to emitter voltage and stability f

```

1 // Example 2.13: Calculate Collector current ,
    Collector to emitter voltage and stability factor

```

```

2 Vcc=20; // Colector voltage in volts
3 Vbe=0.7; // Base to emitter voltage in volts
4 Rb= 200; // in KILLO OHMS
5 Beta=100; //Common emitter D.C. Current gain
6 Rc=20; // Collector resistance in killo ohms
7 Ic= (Vcc-Vbe)/(Rc + (Rb/Beta));
8 Vce=Vcc -(Ic*Rc);
9 S=(1+Beta)/(1+Beta*(Rc/(Rc+Rb)));
10 disp (S,"The Stability factor")
11 disp(Ic,"Collector current in mA")
12 disp(Vce,"Collector to ground voltgae in volts")

```

Scilab code Exa 2.14 base current collector current and stability factor

```

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

```

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


```

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

```

Scilab code Exa 2.16 change in q point

```

1 // Example 2.16: Calculate the change in q point
2 Vcc=20; // Colector voltage in volts
3 Vbe1=0.7; // Base to emitter voltage in volts
4 Vee=20; // emitter voltage in volts
5 Rb= 10; // in KILLO OHMS
6 Beta1=50; //Common emitter D.C. Current gain
7 Rc=5; // Collector resistance in killo ohms
8 Re=10; // Emitter resistance in killo ohms
9 Ie1= (Vee-Vbe1)/(Re+(Rb/Beta1));
10 Ic1=Ie1;
11 Vce1a=Vcc -(Ic1*Rc);
12 Ve=-Vbe1;
13 Vce1=Vce1a-Ve
14 disp(Ie1,"Emitter Current in first case in mA")

```

```

15 disp(Vce1," Collector to ground voltage in in first
    case in volts")
16 Vbe2=0.6; // Base to emitter voltage in volts
17 Beta2=50; //Common emitter D.C. Current gain
18 Ie2= (Vee-Vbe2)/(Re+(Rb/Beta2));
19 Ic2=Ie2;
20 Vce2a=Vcc -(Ic2*Rc);
21 Ve=-Vbe2;
22 Vce2=Vce2a-Ve
23 disp(Ie2," Emitter Current in second case in mA")
24 disp(Vce2," Collector to ground voltage in in first
    case in volts")
25 detaIc= ((1.921-1.892)/1.892)*100;
26 detaVce=((Vce1-Vce2)/Vce2)*100;
27 disp(detaIc," Change in collector current in %")
28 disp(detaVce," Change in collector to emitter voltage
    in %")

```

Scilab code Exa 2.17 input resistance

```

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

```

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

```

1 // Example 2.18: Calculate base current , collector
    current , Collector to emitter voltage , collector
    voltage , base voltage and collector to base
    voltage
2 Vcc=15; // Colector voltage in volts

```

```

3 Rb= 180; // in kilo ohms
4 Beta=100; //Common emitter D.C. Current gain
5 Rc=1.5; // Collector resistance in killo ohms
6 Vbe= 0.7; // Base to emitter voltage in volts
7 Ib= ((Vcc-Vbe)/Rb); //in milli amperes
8 Ic=Beta*Ib; //in milli ampere
9 Vce= Vcc-(Ic*Rc); //Colector to emitter voltage in
    volts
10 Vc=Vce;
11 Vb=Vbe;
12 Vcb=Vc-Vb;
13 disp (Ib,"base current in milli Ampere")
14 disp (Ic,"Collector current in milli Ampere")
15 disp(Vce,"Coolector to emitter voltage In Volts")
16 disp(Vc,"Coolector voltage In Volts")
17 disp(Vb,"Base voltage In Volts")
18 disp(Vcb,"Coolector to base voltage In Volts")

```

Scilab code Exa 2.19 operating point and stability factor

```

1 // Example 2.19: Operating point , stability factor
2 clc;
3 clear;
4 close;
5 Vcc=10; // Colector voltage in volts
6 Rb= 930; // in kilo ohms
7 Beta=100; //Common emitter D.C. Current gain
8 Rc=4; // Collector resistance in killo ohms
9 Vbe= 0.7; // Base to emitter voltage in volts
10 Ib= ((Vcc-Vbe)/Rb); //in milli amperes
11 Ic=Beta*Ib; //in milli ampere
12 Vce= Vcc-(Ic*Rc); //Colector to emitter voltage in
    volts
13 S=(1+Beta);
14 disp ("Operating point is (Vce,Ic) ")

```

```
15 disp(Vce,"Coolector to emitter voltage In Volts")
16 disp (Ic,"Collector current in milli Ampere")
17 disp (S,"The Stability factor")
```

Scilab code Exa 2.20 resistance and stability factor

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

Scilab code Exa 2.21 quiescent point and stability factor

```
1 // Example 2.21: Quiescent , stability factor
2 clc;
3 clear;
4 close;
5 Vcc=10;// Colector voltage in volts
6 Beta=50;//Common emitter D.C. Current gain
7 Rc=2;// Collector resistance in killo ohms
8 Rb= 100;// in kilo ohms
9 Vbe=0;// Base to emitter voltage in volts
10 Ic= (Vcc-Vbe)/(Rc+(Rb/Beta)); //in milli amperes
```

```

11 Ib=Ic/Beta;//in milli ampere
12 Vce= Vcc-(Ic*Rc); //Colector to emitter voltage in
    volts
13 S=(1+Beta)/(1+Beta*(Rc/(Rc+Rb)));
14 disp ("Operating point is (Vce,Ic) ")
15 disp(Vce,"Colector to emitter voltage In Volts")
16 disp (Ic,"Collector current in milli Ampere")
17 disp (S,"The Stability factor")

```

Scilab code Exa 2.22 Collector to emitter bias voltage

```

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

```

Scilab code Exa 2.23 base and collector resistance

```

1 // Example 2.23: Base Currecnt ,Collector current
2 clc;
3 clear;
4 close;

```

```

5 Icbo=0; // collector to base leakage current
6 Vcc=9; // Collector voltage in volts
7 Beta=100; //Common emitter D.C. Current gain
8 Vce=5; // Collector to emitter voltage in volts
9 Ic=0.2; //in milli amperes
10 Rc=(Vcc-Vce)/Ic; // Collector Resistance in ohms
11 Ib=Ic/Beta; //in milli ampere
12 Rb=Vce/Ib; //Base resistance in ohms
13 disp(Rc,"Collector Resistance in ohms")
14 disp(Rb,"Base resistance in ohms")

```

Scilab code Exa 2.24 resistance and stability factor

```

1 // Example 2.24: Base Resistance , stability factor
2 clc;
3 clear;
4 close;
5 Vcc=24; // Collector voltage in volts
6 Beta=45; //Common emitter D.C. Current gain
7 R1=10; // Collector resistance in killo ohms
8 Re=0.27; // Emitter resistance in killo ohms
9 Vce=5; // Collector to emitter voltage in volts
10 Vbe=0.6; // Base to emitter voltage in volts
11 Ib=(Vcc-Vce)/((1+Beta)*(R1+Re)); //in milli ampere
12 Ic=Ib/Beta; // in micro ampere
13 R=(Vce-Vbe)/Ib; // Resistance in killo ohms
14 S=(1+Beta)/(1+Beta*(Re/(Re+R)));
15 disp(R,"Base resistance in killo ohms")
16 disp(S,"The Stability factor")

```

Scilab code Exa 2.25 operating point and stability factor

```

1 // Example 2.25: Quiescent , stability factor

```

```

2  clc;
3  clear;
4  close;
5  Vcc=16; // Colector voltage in volts
6  alfa=0.985;
7  Rc=3; // Colector resistance in killo ohms
8  Re= 2; // in kilo ohms
9  R1= 56; // in kilo ohms
10 R2= 20; // in kilo ohms
11 Vbe=0.3; // Base to emitter voltage in volts
12 Beta= alfa/(1-alfa);
13 Vb=Vcc * (R2/(R1+R2)); // vOLTAGE AT BASE
14 Ic= (Vb-Vbe)/Re; //in milli amperes
15 Ib=Ic/Beta; //in milli ampere
16 Vce= Vcc-(Ic*(Rc+Re)); //Colector to emitter voltage
    in volts
17 Rth= (R1*R2)/(R1+R2);
18 S=((1+Beta)*(1+Rth/Re))/(1+Beta+Rth/Re);
19 disp ("Operating point is (Vce,Ic) ")
20 disp (Vce,"Colector to emitter voltage In Volts")
21 disp (Ic,"Colector current in milli Ampere")
22 disp (S,"The Stability factor")

```

Scilab code Exa 2.26 resistance

```

1  // Example 2.26.a: Find R1,R2 & Re
2  clc;
3  clear;
4  close;
5  Vcc=10; // Colector voltage in volts
6  Beta=50; //Common emitter D.C. Current gain
7  Rc=2; // Colector resistance in killo ohms
8  Vce=4; // Colector to emitter voltage in volts
9  Vbe=0.3; // Base to emitter voltage in volts
10 Ic=2; //Colector current in milli Ampere

```

```

11 Ib=Ic/Beta;//Base current in milli ampere
12 I1=10*Ib;//
13 Ie=Ic;// Emitter current in mili ampere
14 Re=(Vcc-Ic*Rc-Vce)/Ic;//Emiier Resistance
15 V2=Vbe+Ic*Re;//Voltage across R2
16 R2=V2/I1;
17 R1=25-R2;
18 disp(R1,"resistance in killo ohms")
19 disp(R2,"resistance in killo ohms")
20 disp(Re,"emitter resistance in killo ohms")

```

Scilab code Exa 2.27 resistance

```

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

```

Scilab code Exa 2.28 collector current and collector to emitter voltage

```

1 // Example 2.28: Ic ,Vce
2 clc;
3 clear;

```



```

4  close;
5  Vcc=22; // Colector voltage in volts
6  Beta=40;
7  Rc=10; // Colector resistance in killo ohms
8  Re= 1.5; // in kilo ohms
9  R1= 40; // in kilo ohms
10 R2= 4; // in kilo ohms
11 Vbe=0.5; // Base to emitter voltage in volts
12 Vb=Vcc * (R2/(R1+R2)); // vOLTAGE AT BASE
13 Ic= (Vb-Vbe)/Re; //in milli amperes
14 Ib=Ic/Beta; //in milli ampere
15 Vce= Vcc-(Ic*(Rc+Re)); //Colector to emitter voltage
    in volts
16 disp(Vce," Colector to emitter voltage In Volts")
17 disp (Ic," Collector current in milli Ampere")

```

Scilab code Exa 2.29 voltage

```

1  // Example 2.29:Voltage across Re
2  clc;
3  clear;
4  close;
5  Vcc=20; // Colector voltage in volts
6  Beta=50;
7  R1= 60; // in kilo ohms
8  R2= 30; // in kilo ohms
9  Vbe=0.6; // Base to emitter voltage in volts
10 Vb=Vcc * (R2/(R1+R2)); // vOLTAGE AT BASE
11 Ve=Vb-Vbe;
12 disp(Ve," voltage across Re In Volts")

```

Scilab code Exa 2.30 Collector resistance

```

1 // Example 2.30:Voltage across Re
2 clc;
3 clear;
4 close;
5 Vcc=10; //in volts
6 Rb=200; //Base resistance in killo ohms
7 Vbe=0.8; // Base to emitter voltage in volts
8 Beta=100;
9 Vce=0.2; // Collector to emitter voltage in volts
10 Ib=5/Rb; // Base current in milli ampere
11 Ic=Beta*Ib; // Collector current in milli ampere
12 Rc= (Vcc-Vce)/Ic; // Resistance
13 disp(Rc,"Collector resistance in killo ohms")

```

Scilab code Exa 2.31 collector voltage and emitter resistor

```

1 // Example 2.31 Cut off ,Vc & Re
2 clc;
3 clear;
4 close;
5 Vcc=10; //in volts
6 Rc=3; // Collector resistance in killo ohms
7 Rl=0.5; // in kilo ohms
8 Rb=7; // in kilo ohms
9 Beta=100; //Common emitter D.C. Current gain
10 Vbe=0.8; // Base to emitter voltage in volts
11 Ic=2.78; // in mA Applying KVL
12 Ib=0.1; // in mA Applying KVL
13 Ibmin=Ic/Beta;
14 Vc=Vbe; //in saturation region
15 Vce=Vc-Rl*(Ic+Ib);
16 Re=((Vcc-Vce)/Ic)-Rc;
17 disp(Ib,"Base current in mA")
18 disp(Ibmin,"Minimum Base current in mA")
19 disp("As Base current is more than minimum base

```

```
    current so it is in saturation region")
20 disp(Re,"Emitter resistance in killo ohms")
```

Scilab code Exa 2.32 Beta collector voltage and base resistance

```
1 // Example 2.32:Beta ,Vcc & Rb
2 clc;
3 clear;
4 close;
5 Rc=2.7;// Collector resistance in killo ohms
6 Re=0.68;// Collector resistance in killo ohms
7 Ib=0.02;// Base Current in mA
8 Vce=7.3;// Collector to emitter voltage in volts
9 Vbe=0;// Base to emitter voltage in volts
10 Ve=2.1;// Emitter Voltage
11 Ie= Ve/Re;// Emitter Current in mA
12 Ic=Ie;
13 Beta=Ic/Ib;//Common emitter D.C. Current gain
14 Vcc= Vce+Ic*(Rc+Re);//Supply Voltage
15 Rb=(Vcc-Ve)/Ib;//Base resistance in Killo ohms
16 disp(Beta,"Common emitter D.C. Current gain (
    unitless)")
17 disp(Vcc,"Supply Voltage in Volts")
18 disp(Rb,"base resistance in killo ohms")
```

Scilab code Exa 2.33 change in emitter to collector voltage

```
1 // Example 2.33:Ic & Vce
2 clc;
3 clear;
4 close;
5 Vcc=18;// Colector voltage in volts
6 Rc=2.2;// Collector resistance in killo ohms
```

```

7 Rb=510; // Base resistance in killo ohms
8 Re=1.8; // Emitter resistance in killo ohms
9 Beta=90; //Common emitter D.C. Current gain
10 Ib=Vcc/(Rb+Beta*(Rc+Re)); // Base Current in mA
11 Ic=Beta*Ib; // Collector current in mA
12 Beta=Ic/Ib; //Common emitter D.C. Current gain
13 Vce= Ib*Rb; //Collector to emitter voltage in volts
14 disp(Vce,"Colector to emitter voltage In Volts")
15 disp (Ic,"Collector current in milli Ampere")

```

Scilab code Exa 2.34 base current

```

1 // Example 2.33:Ib
2 clc;
3 clear;
4 close;
5 Ie=10; //Emitter current in mA
6 Ic=9.95; //Collector current in mA
7 Ib=Ie-Ic; // Base Current in mA
8 disp(Ib,"Base Current in mA")

```

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

```

1 // Example 2.35: Ic ,Vc, Ve & Vce
2 clc;
3 clear;
4 close;
5 Vcc=30; // Colector voltage in volts
6 Beta=100;
7 Rc=6.2; // Collector resistance in killo ohms
8 Re=1.5; // Emitter resistance in killo ohms
9 Rb=690; // Base resistance in killo ohms
10 Vbe=0.7; // Base to emitter voltage in volts

```

```

11 Ib= (Vcc-Vbe)/(Rb+(1+Beta)*Rc+(1+Beta)*Re);
12 Ic=Ib*Beta;//in milli ampere
13 Ie=Ib*(1+Beta);//in milli ampere
14 Ve=Ie*Re;
15 Vce=Vcc-Ve-(Ic+Ib)*Rc;
16 Vc=Vce+Ve;
17 disp (Ic," Collector current in milli Ampere")
18 disp(Vc," collector voltage In Volts")
19 disp(Ve,"emitter voltage In Volts")
20 disp(Vce," Colector to emitter voltage In Volts")

```

Scilab code Exa 2.36 resistance and stability factor

```

1 // Example 2.36:R1,Rc & S
2 clc;
3 clear;
4 close;
5 Vcc=16;// Colector voltage in volts
6 alfa=0.985;
7 Ieq=2;// Emiier current in mA
8 R2=30;// resistance in killo ohms
9 Re=1;// Emitter resistance in killo ohms
10 Vbe=0.2;// Base to emitter voltage in volts
11 Vceq=6;// Colector to emitter voltage in volts
12 Beta= alfa/(1-alfa);
13 Icq=alfa*Ieq;
14 Rc=(Vcc-Vceq-Ieq*Re)/Icq;
15 Ir1=((Ieq*Re+Vbe)/R2)+Icq/Beta;
16 R1=(Vcc-Vbe-(Ieq*Re))/Ir1;
17 Rb= (R1*R2)/(R1+R2);
18 S=(1+Beta)/(1+Beta*(Re/(Re+Rb)));
19 disp (R1," resistance in killo ohms")
20 disp(Rc," Colector resistance in killo ohms")
21 disp (S,"The Stability factor")

```

Scilab code Exa 2.37.a Biasing components

```
1 // Example 2.37.a: biasing component
2 clc;
3 clear;
4 close;
5 Vcc=12; // Collector voltage in volts
6 Beta=180;
7 Ieq=2; // Emitter current in mA
8 Rc=1; // Collector resistance in kOhms
9 Vbe=0.6; // Base to emitter voltage in volts
10 Vceq=6; // Collector to emitter voltage in volts
11 Ic= (Vcc-Vceq)/Rc;
12 Ib=Ic/Beta;
13 Rb=(Vcc-Vbe)/Ib;
14 disp (Ic, " Collector current in fixed bias case in
      mA")
15 disp (Ib, "Base current in fixed bias case in mA")
16 disp (Rb, "Base resistance in fixed bias case in
      kOhms")
```

Scilab code Exa 2.37.b biasing components

```
1 // Example 2.37.b: biasing component
2 clc;
3 clear;
4 close;
5 Vb=1.6; //
6 Ve=1; //
7 Vcc=12; // Collector voltage in volts
8 Beta=180;
9 Ieq=2; // Emitter current in mA
```

```

10 Rc=1; // Collector resistance in killo ohms
11 Vbe=0.6; // Base to emitter voltage in volts
12 Vceq=6; // Collector to emitter voltage in volts
13 Ic= (Vcc-Vceq-Ve)/Rc;
14 Ib=Ic/Beta;
15 Ie=Ic+Ib*10^-3; //emitter current in milli ampere
16 Re= (Ve/Ie); //emitter resistance in killo ohms
17 Ir2= 10*Ib;
18 R2= (Ve+Vbe)/Ir2; //
19 Ir1=Ir2+Ib; //
20 R1=((Vcc-Vb)/Ir1); //
21 disp (R2," RESISTANCE IN KILLO OHMS")

```

Scilab code Exa 2.38.a stability factor

```

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

```

Scilab code Exa 2.38.b stability factor

```

1 // Example 2.38.b:S
2 clc;
3 clear;
4 close;
5 Beta=180; //Common emitter D.C. Current gain

```

```

6 Re=0.199; // Collector resistance in killo ohms
7 R1=5.76; // resistance in killo ohms
8 R2=34.67; // resistance in killo ohms
9 Rb=(R1*R2)/(R1+R2);
10 S=(1+Beta)/(1+Beta*(Re/(Re+Rb)));
11 disp(S," Stability factor in self bias case is")

```

Scilab code Exa 2.39.a change in collector current

```

1 // Example 2.39.a: Stability factor
2 clc;
3 clear;
4 close;
5 R1=500; //Resistance in killo ohms
6 Rc=500; //Collector resistance in killo ohms
7 R2=5000; //Resistance in killo ohms
8 Vcc=20; // Colector voltage in volts
9 Beta=75;
10 Rc=6.2; // Collector resistance in killo ohms
11 Re=90; // Emitter resistance in ohms
12 Rb=690; // Base resistance in killo ohms
13 Vbe=0.7; // Base to emitter voltage in volts
14 Rb=((R1*R2)/(R1+R2));
15 Vb=Vcc * (R1/(R1+R2)); // vOLTAGE AT BASE
16 Icbo=0.02; // Collector to base leakage current in mA
17 Sre= (Re/(Rb+Re*Beta)^2)*(Icbo*10^-6*Rb-Beta(Vb+Rb*
    Icbo*10^-6-Vbe));
18 disp(Sre," Stability factor in A/ohms is")

```

Scilab code Exa 2.39.b change in collector current

```

1 // Example 2.39.b: Change in Icq
2 clc;

```



```

3 clear;
4 close;
5 R1=500; // Resistance in killo ohms
6 Rc=500; // Collector resistance in killo ohms
7 R2=5000; // Resistance in killo ohms
8 Vcc=20; // Colector voltage in volts
9 Beta=75;
10 Rc=6.2; // Collector resistance in killo ohms
11 Re=90; // Emitter resistance in ohms
12 Vbe=0.7; // Base to emitter voltage in volts
13 Rb=((R1*R2)/(R1+R2));
14 Vb=Vcc * (R1/(R1+R2)); // vOLTAGE AT BASE
15 Icbo=0.02; // Collector to base leakage current in mA
16 Sre= (Re/(Rb+Re*Beta)^2)*(Icbo*10^-6*Rb-Beta(Vb+Rb*
    Icbo*10^-6-Vbe));
17 DeltaRe= 110-90; // Change in ohms
18 DeltaIcq= Sre*DeltaRe ; // Change in Icq
19 disp(DeltaIcq," Change in Icq in amperes")

```

Scilab code Exa 2.40 resistance

```

1 // Example 2.39.b: R1 & R2
2 clc;
3 clear;
4 close;
5 Vcc=5; // Colector voltage in volts
6 Beta=100;
7 Vce=2.5; // Collector to emitter voltage in volts
8 Vbe=0.6; // Base to emitter voltage in volts
9 R4=0.3; // Resistance in killo ohms
10 R2=10; // Resistance in killo ohms
11 Ic=1; // Collector current in mA
12 Vr4=(1+(1/Beta))*Ic*R4;
13 Vcn= Vce-Vr4;
14 R3=(Vcc-Vcn)/Ic;

```

```

15 Rb=8.03; // Base resistance in killo ohms
16 R1=(Rb*R2)/(R2-Rb);
17 disp(R1,"Resistance in killo ohms")
18 disp(Rb,"Base Resistance in killo ohms")

```

Scilab code Exa 2.41 resistance and stability factor

```

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

```

Scilab code Exa 2.42 quiescent current

```

1 // Example 2.42: Icq
2 clc;
3 clear;
4 close;
5 T2=20; // Temperature in degree celsius
6 T1=0; // Temperature in degree celsius
7 Vcc=15; // Colector voltage in volts

```

```

8  Beta=75;
9  Vce=2.5; // Collector to emitter voltage in volts
10 Vbe1=0.7; // Base to emitter voltage in volts
11 Rb= 50; // Emitter resistance in killo ohms
12 Rc=3; // Collector resistance in killo ohms
13 Re=1; // Collector resistance in killo ohms
14 Ib= ((6-Vbe1)/(Rb+(1+Beta)*Re))*10^3; //Base Current
    in Micro Amperes
15 Ic= Beta*Ib*10^-3; // Colectore Current in Milli
    Ampere
16 Icbo1=0.5; // Collector to base leakage current in
    Micrometer
17 Icbo2=Icbo1*2^((T2-T1)/10); // Collector to base
    leakage current in Micrometer when temperature 20
    degree celsius
18 Vbe2=Vbe1-2*T2*10^-3; // base to emitter voltage when
    temperature is 20 degree celsius
19 Ib1=((6-Vbe2)/(Rb+(1+Beta)*Re))*10^3; //Base Current
    in Micro Amperes at 20 degree celsius
20 Ic1=Beta*Ib*10^-3; // Colectore Current in Milli
    Ampere
21 disp(Ib,"Base Current in micro amperes")
22 disp(Ic,"Collector current in mA")
23 disp(Icbo2,"Collector to base leakage current when T
    =20 degree celsius in micro ampere")
24 disp(Vbe2,"Base to emitter voltage when T==20 degree
    celsius in VOLTS ")
25 disp(Ib1,"Base Current when T=20 degree celsius in
    micro amperes")
26 disp(Ic1,"Collector current when T=20 degree celsius
    in mA")

```

Scilab code Exa 2.43 quiescent currents

```

1 // Example 2.43:(a) quiescent current (b) drift in
   quiescent current
2 clc;
3 clear;
4 close;
5 Beta1=50; //gain at 25 degree celsius temperture
6 Beta2=200; //gain at 75 degree celsius temperture
7 Rb=1; //base resistance in killo ohms
8 Re=0.1; //emitter resistance in ohms
9 Ico1=0.01; //leakage current at 25 degree celsius
   temperture in micro ampere
10 Ico2=0.045; //leakage current at 75 degree celsius
   temperture in micro ampere
11 Vbe1=0.7; //base to emitter voltage 25 degree
   celsius temperture in micro ampere
12 Vbe2=0.575; //base to emitter voltage 75 degree
   celsius temperture in micro ampere
13 dBeta=Beta2-Beta1; //Change in gain
14 dIco=Ico2-Ico1; //change in leakage current
15 dVbe=Vbe2-Vbe1; //change in base to emitter voltage
16 Ib= (1-Vbe1)/(Rb+(1+Beta1)*Re); //Base current in
   micro ampere
17 Ic=Beta1*Ib; //Collector current in milli ampere
18 S=((1+Beta1)*(1+(Rb/Re)))/(1+Beta1+(Rb/Re)); //
   stability factor
19 S1=- (Beta1/Re*10^-3)/(1+Beta1+(Rb/Re)); //stability
   factor
20 S2=(S*Ic*10^-3)/(Beta1*(1+Beta1)); //stability factor
21 dIc= ((S*dIco*10^-6)+(S1*dVbe)+(S2*dBeta))*10^3; //
   change in collector current
22 Icn= Ic+dIc; //new collector current in milli ampere
23 disp(Ic,"quiescent current in milli ampere is")
24 disp(dIc,"quiescent current drift at temperature 75
   degree celsius is in milli ampere")
25 disp(Icn,"new quiescent current in milli ampere is"
   )

```

Scilab code Exa 2.44.a resistance

```
1 // Example 2.44.a:R1,R2 ,Re
2 clc;
3 clear;
4 close;
5 Vbe=0.2; //
6 Vcc=16; //collector voltage in volts
7 Rc=1.5; //collector resistance in killo ohms
8 S=12; //stability factor
9 Vce=8; // Collector to emitter voltage
10 Ic=4; //in milli amperes
11 Beta=50; //gain
12 Ib=(Ic*10^-3)/Beta; // Base current in micro ampere
13 Re=(Vcc-Vce-(Rc*10^3*Ic*10^-3))/(Ic*10^-3+Ib); //
    emitter resistance in ohms
14 Rb=((11*(1+Beta))/(Beta-11))*Re*10^-3; //base
    resistance in killo ohms
15 Vr2= Vbe+(Ic+Ib*10^3)*Re*10^-3; //voltage is R2
16 x=(Vr2/Vcc); //Voltage
17 R1=(Rb)/x; //resistance in killo ohms
18 R2=(x*R1)/(1-x); //RESISTANCE IN KILLO OHMS
19 S1=3; //REDUCED STABILITY FACTOR
20 Rb1=((3*(1+Beta))/(Beta-3))*Re*10^-3; //EFFECT OF
    REDUCING STABILITY FACTOR ON BASE RESISTANCE
21 disp(Re*10^-3,"emitter resistance in killo ohms")
22 disp(R1,"resistance in killo ohms")
23 disp(R2,"resistance in killo ohms")
```

Scilab code Exa 2.44.b resistance

```
1 // Example 2.44.a:R1,R2 ,Re
```

```

2  clc;
3  clear;
4  close;
5  Vbe=0.2; //
6  Vcc=16; //collector voltage in volts
7  Rc=1.5; //collector resistance in killo ohms
8  S=12; //stability factor
9  Vce=8; // Collector to emitter voltage
10 Ic=4; //in milli amperes
11 Beta=50; //gain
12 Ib=(Ic*10^-3)/Beta; // Base current in micro ampere
13 Re=(Vcc-Vce-(Rc*10^3*Ic*10^-3))/(Ic*10^-3+Ib); //
    emitter resistance in ohms
14 Rb=((2*(1+Beta))/(Beta-2))*Re*10^-3; //base
    resistance in killo ohms
15 Vr2= Vbe+(Ic+Ib*10^3)*Re*10^-3; //voltage is R2
16 x=(Vr2/Vcc); //Voltage
17 R1=(Rb)/x; //resistance in killo ohms
18 R2=(x*R1)/(1-x); //RESISTANCE IN KILLO OHMS
19 S1=3; //REDUCED STABILITY FACTOR
20 Rb1=((3*(1+Beta))/(Beta-3))*Re*10^-3; //EFFECT OF
    REDUCING STABILITY FACTOR ON BASE RESISTANCE
21 disp(Re*10^-3,"emitter resistance in killo ohms")
22 disp(R1,"resistance in killo ohms")
23 disp(R2,"resistance in killo ohms")

```

Scilab code Exa 2.45 resistance

```

1  // Example 2.45:R1,R2 ,Re
2  clc;
3  clear;
4  close;
5  Vbe=0.2; //
6  Vcc=20; //collector voltage in volts
7  Rc=2; //collector resistance in killo ohms

```

```

8 S=10; //stability factor
9 Vce=10; // Collector to emitter voltage
10 Ic=4; //in milli amperes
11 Beta=50; //gain
12 Ib=(Ic*10^-3)/Beta; // Base current in micro ampere
13 Re=(Vcc-Vce-(Rc*10^3*Ic*10^-3))/(Ic*10^-3+Ib); //
    emitter resistance in ohms
14 Rb=((9*(1+Beta))/(Beta-9))*Re*10^-3; //base
    resistance in killo ohms
15 Vr2= Vbe+(Ic+Ib*10^3)*Re*10^-3; //voltage is R2
16 x=(Vr2/Vcc); //Voltage
17 R1=(Rb)/x; //resistance in killo ohms
18 R2=(x*R1)/(1-x); //RESISTANCE IN KILLO OHMS
19 S1=3; //REDUCED STABILITY FACTOR
20 Rb1=((3*(1+Beta))/(Beta-3))*Re*10^-3; //EFFECT OF
    REDUCING STABILITY FACTOR ON BASE RESISTANCE
21 disp(Re,"emitter resistance in ohms")
22 disp(R1,"resistance in killo ohms")
23 disp(R2,"resistance in killo ohms")
24 disp(Rb1,"base resistance in killo ohms effect of
    reducing stability factor reduces input impedance
    ")

```

Scilab code Exa 2.46 resistance

```

1 // Example 2.46:R1,R2 ,Re
2 clc;
3 clear;
4 close;
5 S=2; //stability factor
6 Vbe=0.8; //
7 Vcc=20; //collector voltage in volts
8 Rc=5; //collector resistance in killo ohms
9 Vce=11.5; // Collector to emitter voltage
10 Ic=1.5; //in milli amperes

```

```

11 Beta=50; //gain
12 Ib=(Ic*10^-3)/Beta; // Base current in micro ampere
13 Re=(Vcc-Vce-(Rc*10^3*Ic*10^-3))/(Ic*10^-3+Ib); //
    emitter resistance in ohms
14 Rb=((1+Beta)/(Beta-1))*Re; //base resistance in
    killo ohms
15 Vr2= Vbe+(Ic+Ib*10^3)*Re*10^-3; //voltage is R2
16 x=(Vr2/Vcc); //Voltage
17 R1=((Rb)/x)*10^-3; //resistance in killo ohms
18 R2=((x*R1)/(1-x))*10^3; //RESISTANCE IN KILLO OHMS
19 disp(Re,"emitter resistance in ohms")
20 disp(R1,"resistance in killo ohms")
21 disp(R2,"resistance in killo ohms")

```

Scilab code Exa 2.47 current gain input resistance and voltage gain

```

1 // Example 2.47: Ai, Ri, Av
2 clc;
3 clear;
4 close;
5 Rs=800; //Internal resistance in ohms
6 Rl=1000; //Load resistance in ohms
7 //H Paramters are
8 Hie=1; //in killo ohms
9 Hre=2*10^-4;
10 Hfe=50;
11 Hoe=25*10^-6; // in ampere per volt
12 Ai= -Hfe/(1+Hoe*Rl); // Current gain
13 Ri= Hie*10^3-((Hfe*Hre)/(Hoe+(1/Rl))); // Input
    resistance in ohms
14 Av= Ai*(Rl/Ri); // Voltage Gain
15 disp(Ai,"Current gain is")
16 disp(Ri,"Input resistance in ohms is")
17 disp(Av,"Voltage gain is")

```

Scilab code Exa 2.48 current gain input resistance and voltage gain

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

Scilab code Exa 2.49 current gain input resistance and voltage gain

```
1 // Example 2.49: Ai, Ri, Av, Avs, Ais
2 clc;
3 clear;
4 close;
5 Rl=1000; //Load resistance in ohms
6 Rs=1200; // Internal Resistance
7 //H Paramters are
8 Hib=22; //in ohms
```

```

9 Hrb=3*10^-4;
10 Hfb=-0.98;
11 Hob=0.5*10^-6; // in ampere per volt
12 Ai= -Hfb/(1+Hob*Rl); // Current gain
13 Ri= Hib+(Hrb*Ai*Rl); // Input resistance in ohms
14 Av=(Ai*(Rl/Ri)); // Voltage Gain
15 dh=(Hib*Hob)-(Hrb*Hfb);
16 Avs=(Av*Ri)/(Ri+Rs); // Overall Voltage gain
17 Ais=(Ai*Rs)/(Ri+Rs); // Overall Current gain
18 disp(Ai,"Current gain is")
19 disp(Ri,"Input resistance in ohms is")
20 disp(Av,"Voltage gain is")
21 disp(Ais,"Overall Current gain is")
22 disp(Avs,"Overall Voltage gain is")

```

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

```

1 // Example 2.50: Ai, Ri, Av, Ro
2 clc;
3 clear;
4 close;
5 Rl=5000; //Load resistance in ohms
6 Rs=1000; //Source internal resistance
7 R1=10; //Resistance in killo ohms
8 R2=10; //Resistance in killo ohms
9 Re=5*10^3; //Emitter resistance in ohms
10 //H Paramters are
11 Hic=2; //in killo ohms
12 Hrc=1;
13 Hfc=-51;
14 Hoc=25*10^-6; // in ampere per volt
15 Ai= -Hfc/(1+Hoc*Rl); // Current gain
16 Ri= (Hic+(Hrc*Ai*Rl))*10^-3; // Input resistance in
    killo ohms
17 Z1= (R1*R2)/(R1+R2); //

```

```

18 Zi=(Ri*Z1)/(Ri+Z1);// input resistance of amplifier
    stage in killo ohms
19 Av=round((Ai*(R1/Ri))*10^-3)// Voltage Gain
20 Ro=-(Rs+Hic*10^3)/Hfc;// Output resistance in ohms
21 Zo= (Ro*Re)/(Ro+Re);//output resistance of amplifier
    stage in ohms
22 disp(Ai,"Current gain is")
23 disp(Ri,"Input resistance in ohms is")
24 disp(Av,"Voltage gain is")
25 disp(Zi,"input resistance of amplifier stage in
    killo ohms")
26 disp(Ro,"Output resistance in ohms")
27 disp(Zo,"output resistance of amplifier stage in
    ohms")

```

Scilab code Exa 2.51 current gain input resistance and voltage gain

```

1 // Example 2.51: Ai, Ri, Av, Z0
2 clc;
3 clear;
4 close;
5 R1=20;//Resistance in killo ohms
6 R2=10;//Resistance in killo ohms
7 Rc=5;//collector resistance in killo ohms
8 R=10;//resistance in killo ohms
9 Rs=800;//Internal resistance in ohms
10 Rl=(Rc*R)/(Rc+R);//Load resistance in killo ohms
11 //H Paramters are
12 Hie=1.5;//in killo ohms
13 Hre=5*10^-3;
14 Hfe=50;
15 Hoe=2*10^-6;// in micro ampere per volt
16 Ai= -Hfe;// Current gain
17 Ri= Hie;// Input resistance in ohms
18 Z1= (R1*R2)/(R1+R2);//

```

```

19 Zi=(Ri*Z1)/(Ri+Z1);// input resistance of amplifier
    stage in killo ohms
20 Av= round(Ai*(Rl/Ri));// Voltage Gain
21 Ro=(1/Hoe)*10^3;//output resistane in killo ohms
22 Zo=(Ro*Rl)/(Ro+Rl);//output resistance of amplifier
    stage in ohms
23 disp(Ai,"Current gain is")
24 disp(Zi,"input resistance of amplifier stage in
    killo ohms")
25 disp(Av,"Voltage gain is")
26 disp(Zo,"output resistance of amplifier stage in
    ohms")

```

Scilab code Exa 2.52 current gain input resistance and voltage gain

```

1 // Example 2.52: Ai, Ri, Av
2 clc;
3 clear;
4 close;
5 Rs=0.5;//Internal resistance in killo ohms
6 Rl=5;//Load resistance in killo ohms
7 //H Paramters are
8 Hie=1;//in killo ohms
9 Hfe=50;
10 Hoe=25*10^-6;// in ampere per volt
11 Ai= (1+Hfe)/(1+Hoe*Rl*10^3);// Current gain
12 Ri= Hie+(Ai*Rl);// Input resistance in killo ohms
13 Av= Ai*(Rl/Ri);// Voltage Gain
14 disp(Ai,"Current gain is")
15 disp(Ri,"Input resistance in killo ohms is")
16 disp(Av,"Voltage gain is")

```

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

```

1 // Example 2.53: Ai, Ri, Av
2 clc;
3 clear;
4 close;
5 Rs=1; //Internal resistance in ohms
6 Rl=1600; //Load resistance in ohms
7 //H Paramters are
8 Hie=1100; //in ohms
9 Hfe=2.5*10^-4;
10 Hoe=25*10^-6; // in ampere per volt
11 Ai= -Hfe/(1+Hoe*Rl); // Current gain
12 Ri= round(Hie+(Ai*Rl)); // Input resistance in ohms
13 Av= Ai*(Rl/Ri); // Voltage Gain
14 Pg=Ai*Av; //
15 disp(Ai, "Current gain is")
16 disp(Ri, "Input resistance in killo ohms is")
17 disp(Av, "Voltage gain is")
18 disp(Pg, "Power gain is")

```

Scilab code Exa 2.54.a quiescent point

```

1 // Example 2.54.a: Icq, Vcq
2 clc;
3 clear;
4 close;
5 Vbe=0; //
6 Vcc=18; //collector voltage in volts
7 R1=510; //resistance in killo ohms
8 R2=510; //resistance in killo ohms
9 Rc=9.1; //clollector resistance in killo ohms
10 Re=7.5; //emitter resistance in killo ohms
11 Rs=1; //Internal resistance in ohms
12 Rl=1600; //Load resistance in ohms
13 Vb=Vcc * (R2/(R1+R2)); // vOLTAGE AT BASE
14 Ic= (Vb-Vbe)/Re; //in milli amperes

```

```

15 Vce= Vcc-(Ic*(Rc+Re)); //Colector to emitter voltage
    in volts
16 //H Paramters are
17 Hie=1100;//in ohms
18 Hfe=2.5*10^-4;
19 Hoe=25*10^-6;// in ampere per volt
20 Ai= -Hfe/(1+Hoe*Rl);// Current gain
21 Ri= round(Hie+(Ai*Rl));// Input resistance in ohms
22 Av= Ai*(Rl/Ri);// Voltage Gain
23 disp(Vce,"Colector to emitter voltage In Volts")
24 disp (Ic,"Colector current in milli Ampere")

```

Scilab code Exa 2.54.b voltage gain and input resistance

```

1 // Example 2.54.b:Av,Ri
2 clc;
3 clear;
4 close;
5 Vbe=0;//
6 Vcc=18;//collector voltage in volts
7 R1=510;//resistance in killo ohms
8 R2=510;//resistance in killo ohms
9 Rc=9.1;//clollector resistance in killo ohms
10 Re=7.5;//emitter resistance in killo ohms
11 Rs=1;//Internal resistance in ohms
12 Rl=1600;//Load resistance in ohms
13 Vb=Vcc * (R2/(R1+R2)); // vOLTAGE AT BASE
14 Ic= (Vb-Vbe)/Re; //in milli amperes
15 Vce= Vcc-(Ic*(Rc+Re)); //Colector to emitter voltage
    in volts
16 //H Paramters are
17 Hie=1;//in killo ohms
18 Hfe=50;
19 Hoe=0;// in ampere per volt
20 Ai=-Hfe;//current gain

```

```

21 Ri=Hie; // Input resistance in ohms
22 Z1= (R1*R2)/(R1+R2); //
23 Zi=(Ri*Z1)/(Ri+Z1); // input resistance of amplifier
    stage in killo ohms
24 Av= Ai*(Rc/Ri); // Voltage Gain
25 disp(Zi,"input resistance of amplifier stage in
    killo ohms")
26 disp(Av,"Voltage gain is")

```

Scilab code Exa 2.55 resistive parameters

```

1 // Example 2.55: resistive parameters
2 clc;
3 clear;
4 close;
5 Ic= 5; //in milli amperes
6 Vt=26; //voltage
7 //H Parameters are
8 hie=1; //in killo ohms
9 hfe=100;
10 hoe=4*10^-5; // in ampere per volt
11 hre=10^-4;
12 gm=Ic/Vt; //transconductance
13 rbe= hfe/gm; // in ohms
14 rbb=hie*10^3-rbe; //in ohms
15 rbc=(rbe/(hre)*10^-6); //in mega ohms
16 gce1=hoe-(1+hfe)*(1/(rbc*10^6)); //in mho
17 rce=(1/gce1)*10^-3; //in killo ohms
18 disp(gm,"transconductance")
19 disp(rbe,"in ohms")
20 disp(rbc,"in mega ohms")
21 disp(rbb,"in ohms")
22 disp(gce1,"in mho")
23 disp(rce,"in killo ohms")

```

Scilab code Exa 2.56 resistive parameters

```
1 // Example 2.56: resistive parameters
2 clc;
3 clear;
4 close;
5 Ic= 1; //in milli amperes
6 Vt=26; //volatge
7 ft=80; //frequency in mega hertz
8 Cbc=12; //in pico farad
9 //H Paramters are
10 hie=6; //in killo ohms
11 hfe=224;
12 gm=Ic/Vt; //transconductance
13 rbe= hfe/gm; // in ohms
14 rbb=hie*10^3-rbe; //in ohms
15 Cbe= (((gm)/(2*pi*ft*10^6))-Cbc*10^-12)*10^12; //in
    pico farad
16 disp(gm,"transconductance")
17 disp(rbe,"in ohms")
18 disp(rbb,"in ohms")
19 disp(Cbe,"in pico farad")
```

Scilab code Exa 2.57 cut off frequencies

```
1 // Example 2.57: alpha ,beta and cut off frequencies
2 clc;
3 clear;
4 close;
5 Cbc=12; //in pico farad
6 //H Paramters are
7 hie=6; //in killo ohms
```



```

8 hfe=224;
9 gm=38; //transconductance
10 rbe=5.9; // in killo ohms
11 rbb=100; //in ohms
12 Cbe= 63; //in pico farad
13 falpha= ((hfe)/(2*pi*rbe*10^3*Cbe*10^-12))*10^-6; //
14 fbeta= ((1)/(2*pi*rbe*10^3*(Cbe+Cbc)*10^-12))
        *10^-6; //
15 ft= ((gm*10^-3/(2*pi*(Cbe+Cbc)*10^-12))*10^-6; //
16 disp(falpha,"in mega hertz")
17 disp(fbeta,"in mega hertz")
18 disp(ft,"in mega hertz")

```

Scilab code Exa 2.58 resistive parameters

```

1 // Example 2.58:ressitive paramters
2 clc;
3 clear;
4 close;
5 Ic= 2.6; //in milli amperes
6 Vt=26; //volatge
7 ft=500; //frequency in mega hertz
8 Cbc=3; //in pico farad
9 rbb=100; //in ohms
10 rbe=1; //IN KILLO OHMS
11 gm=Ic/Vt; //transconductance
12 Beta= gm*rbe*10^3; //
13 Cbe= (((gm)/(2*pi*ft*10^6))-Cbc*10^-12)*10^12; //in
        pico farad
14 disp(gm,"transconductance")
15 disp(Cbe,"in pico farad")

```

Scilab code Exa 2.59 h parameters and hybrid parameters

```

1 // Example 2.59:h parameters and hybrid parameters
2 clc;
3 clear;
4 //H Paramters are
5 hie=1100;//in killo ohms
6 hre=2*10^-4;
7 hfe=50;
8 hoe=2.5*10^-5;// in ampere per volt
9 hic=hie;//
10 hrc=1-hre;//
11 hfc=-(1+hfe);//
12 hoc=hoe;//
13 hib=(hie/(1+hfe));//
14 hrb= ((hie*hoe)/(1+hfe))-hre;//
15 hob=(hoe/(1+hfe));//
16 rbb=100;
17 rbe=(hie-rbb)*10^-3;//in killo ohms
18 rbc= ((hie-rbb)/hre)*10^-6;//
19 gm= ((hfe/(hie-rbb)));//
20 x=hoe-((hfe*hre)/(hie-rbb));//
21 rce=1/(1.25*10^-2);//
22 disp(hic," hic=" ,hrc," hrc=" ,hfc," hfc=" ,hoc," hoc=" ,"H-
    parameters for common collector configuration are
    ")
23 disp(hib," hib=" ,hrb," hrb=" ,hob," hob=" ,"H-parameters
    for common collector configuration are")
24 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

```

1 // Example 2.60:hybrid parameters
2 clc;
3 clear;

```

```

4 Ic= 10; //in milli amperes
5 Vt=26; //volatge
6 ft=500; //frequency in mega hertz
7 Cbc=3; //in pico farad
8 gm=Ic/Vt; //transconductance
9 //H Paramters are
10 hie=500; //in killo ohms
11 hfe=100;
12 hre=0.1; //
13 hoe=4*10^-5; // in ampere per volt
14 rbe=hfe/gm; // in ohms
15 rbc= ((rbe)/hre)*10^-3; //
16 x=hoe-((hfe*10^-4)/(rbe)); //
17 rce=(1/(x*10^-2))*10^-5; //
18 Cbe=(((gm)/(2*pi*ft*10^6))*10^13-Cbc); //in pico
    farad
19 disp(gm, "(gm) transconductance")
20 disp(rbe, "(rbe) in ohms")
21 disp(rbc, "(rbc) in mega ohms")
22 disp(rce, "(rce) in killo ohms")
23 disp(Cbe, "(Cbe) in pico farad")

```

Scilab code Exa 2.61 hybrid parameters

```

1 // Example 2.61: hybrid parameters
2 clc;
3 clear;
4 Ai=10; //current gain
5 Vce=10; //
6 Ic= 10; //in milli amperes
7 Vt=26; //volatge
8 f=10 //frequency in mega hertz
9 Cbc=3; //in pico farad
10 gm=Ic/Vt; //transconductance
11 //H Paramters are

```

```

12 hie=500; //in ohms
13 hfe=100;
14 rbe= hfe/gm; //
15 rbb= hie-rbe; //
16 Ft= Ai*f; //in mega hertz
17 fb= Ft/hfe; //
18 Ce=((gm/(2*%pi*Ft*10^6))-Cbc*10^-12)*10^12; //
19 disp(gm*10^3,"(gm) in mS")
20 disp(rbe,"(rbe) in ohms")
21 disp(rbb,"(rbb) in ohms")
22 disp(Ft,"(ft) in mega hertz")
23 disp(fb,"(fb) in mega hertz")
24 disp(Ce,"(Ce) in picofarad")

```

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

```

1 // Example 2.62:mid band voltage gain and cut off
  frequency
2 clc;
3 clear;
4 Rs=1; //
5 ft=500 //frequency in mega hertz
6 Cbc=5; //in pico farad
7 //H Paramters are
8 hie=500; //in ohms
9 hfe=100;
10 rbe= 900; // // //
11 rbb= 100; //
12 Rl=500; //load resistance in ohms
13 gm=hfe/rbe; //in mho
14 Av=(-gm*Rl); //voltage gain
15 Avs= ((Av*rbe)/(Rs*10^3+rbb+rbe)); //mid band voltage
  gain
16 fb= ft/hfe; //
17 disp(Avs,"(Avs)mid band voltage gain is")

```

```
18 disp(fb,"(fb) in mega hertz")
```

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

```
1 // Example 2.63:mid band voltage gain and cut off
  frequency
2 clc;
3 clear;
4 Rs=1; //
5 ft=500 //frequency in mega hertz
6 Cbc=5; //in pico farad
7 //H Paramters are
8 gm=100; //in mho
9 hfe=100; //
10 rbe=hfe/(gm*10^-3); // in ohms
11 rbb= 100; //
12 Rl=500; //load resistance in ohms
13 Av=((-gm*10^-3*Rl)); //voltage gain
14 Avs= ((Av*rbe)/(Rs*10^3+rbb+rbe)); //mid band voltage
  gain
15 fb= ft/hfe; //
16 disp(Avs,"(Avs)mid band voltage gain is")
17 disp(fb,"(fb) in mega hertz")
```

Scilab code Exa 2.64 resonant frequency and voltage drop

```
1 // Example 2.64:resonant frequency and voltage drop
2 clc;
3 clear;
4 L=100; //in micro henry
5 C=253.3; //in micro farad
6 R=15.7; //in ohms
```

```

7 fr=((1/(2*%pi*sqrt(L*10^-6*C*10^-12))))*10^-6; //
    resonant frequency in mega hertz
8 V=0.157; //
9 Ir=V/R; //
10 Vr=V; //
11 Vl=Ir*(2*%pi*fr*10^6*L*10^-6); //
12 Xc= (1/(2*%pi*fr*10^6*C*10^-12)); //
13 Vc= Ir*Xc; //
14 Q=((2*%pi*fr*10^6*L*10^-6)/R);
15 disp(fr,"resonant frequency in mega hertz")
16 disp(Vr,"Voltage drop across ressitance")
17 disp(Vl,"Voltage drop across inductor")
18 disp(Vc,"Voltage drop across capacitor")
19 disp(Q,"Quality factor of coil is")

```

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

```

1 // Example 2.65: resonant frequency , impedance , Q-
    factor , Bnadwidth , line current and resonant
    frequency
2 clc;
3 clear;
4 V=10; //
5 L=1.2; //in micro henry
6 C=200; //in micro farad
7 R=8; //in ohms
8 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
9 Zr=(L*10^-3)/(C*10^-9*R); //IN KILLO OHMS
10 Q=((2*%pi*fr*10^6*L*10^-6)/R);
11 BW=fr/Q; //
12 Ir=(V/Zr)*10^3; //
13 fr1=((1/(2*%pi*sqrt(L*10^-3*C*10^-12))))*10^-3; //
    resonant frequency in mega hertz

```

```

14 disp(fr,"resonant frequency in killo hertz")
15 disp(Zr,"Impedence in kilo ohms is")
16 disp(BW,"bandwidth in killo hertz is")
17 disp(Ir,"line current in milli ampere")
18 disp(Q,"Quality factor of coil is")
19 disp(fr1,"resonant frequency in killo hertz
    neglecting resistance")

```

Scilab code Exa 2.66 resonant frequency impedance q factor and bandwidth

```

1 // Example 2.66:resonant frequency ,impedence ,Q-
  factor ,Bnadwidth
2 clc;
3 clear;
4 V=10; //
5 L=150; //in micro henry
6 C=100; //in micro farad
7 R=5; //in ohms
8 fr=((1/(2*%pi*sqrt(L*10^-6*C*10^-12))))*10^-3; //
  resonant frequency in killo hertz
9 Zr=(L*10^-3)/(C*10^-9*R); //IN KILLO OHMS
10 Q=((2*%pi*fr*10^6*L*10^-6)/R)*10^-3;
11 BW=(fr/Q); //
12 disp(fr,"resonant frequency in killo hertz")
13 disp(Zr*10^-3,"Impedence in kilo ohms is")
14 disp(BW,"bandwidth in killo hertz is")
15 disp(Q,"Quality factor of coil is")

```

Scilab code Exa 2.67 Q FACTOR

```

1 // Example 2.67:Q FACTOR
2 clc;
3 clear;

```

```
4 fr=1600;//resonant frequency in killo hertz
5 BW=10;//In kill hertz
6 Qr=fr/BW;
7 disp(Qr,"value of quality factor is")
```

Scilab code Exa 2.68 Q FACTOR

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

Scilab code Exa 2.69 PARALLEL IMPEDENCE

```
1 // Example 2.69:parallel impedance
2 clc;
3 clear;
4 fr=445*10^3;//resonant frequency in hertz
5 BW=10*10^3;// hertz
6 Xl=1255;// inductive reactance in ohm
7 Qr=fr/BW;
8 R=Xl/Qr;
9 L=Xl/(2*%pi*fr);
10 C=1/(2*%pi*fr*Xl);
11 Zp=(L/(C*R))*10^-3;
12 disp(Qr,"value of quality factor is")
13 disp(R,"resisitance = (ohm)")
14 disp(L,"inductance = (H)")
15 disp(C,"capacitor= (F)")
16 disp(Zp,"parallel impedance = (killo ohm)")
```


Chapter 3

TRANSISTOR AMPLIFIERS

Scilab code Exa 3.1 input impedance output impedance and current gain

```
1 // Example 3.1: calculate the input impedance,
   output impedance, voltage gain and current gain
2 clc, clear
3 Hie=500; // the h-parameters of the transistor in
   ohm
4 Hfe=60; // the h-parameters of the transistor in ohm
5 Ic=3*10^-3; // collector current in ampere
6 Rb=220*10^3; // resistance in ohm
7 Rc=5.1*10^3; // resistance in ohm
8 zi=Hie;
9 zo=Rc;
10 Av=-Hfe*Rc/Hie;
11 Ai=-Hfe
12 Vcc=12; // voltage in volts
13 Vbe=0.6; // voltage in volts
14 Beta=60; // for transistor
15 Ib=(Vcc-Vbe)/Rb;
16 Ie=Beta*Ib;
17 re=26*10^-3/Ie;
18 Zin=Beta*re;
19 Zout=Rc;
```

```

20 Av1=-Rc/re;
21 Ai1=-Beta;
22 disp("part 1 -from h-parameter model")
23 disp(zi,"input impedance (ohm) = ")
24 disp(zo,"ouput impedance (ohm) = ")
25 disp(Ai,"current gain (unitless) = ")
26 disp(Av,"voltage gain (unitless) = ")
27 disp("part 2 -from re model")
28 disp(Ib,"base curret (A) = ")
29 disp(Ie,"emitter curret (A) = ")
30 disp(re,"resistance = ")
31 disp(Zin,"input impedance (ohm) = ")
32 disp(Zout,"ouput impedance (ohm) = ")
33 disp(Ai1,"current gain (unitless) = ")
34 disp(Av1,"voltage gain (unitless) = ")

```

Scilab code Exa 3.2 input impedance output impedance and current gain

```

1 // Example 3.2: calculate the input impedance,
   output impedance, voltage gain and current gain
2 clc, clear;
3 Hie=3.2; // the h-parameters of the transistor in
   kilo-ohm
4 Hfe=100; // the h-parameters of the transistor
5 R1=40; // resistance in kilo-ohm
6 R2=4.7; // resistance in kilo-ohm;
7 Rc=4; // resistance in kilo-ohm;
8 Re=1.2; // resistance in kilo-ohm;
9 Rb=(R1*R2)/(R1+R2);
10 zi=(Rb*Hie)/(Rb+Hie);
11 zo=Rc;
12 Av=-(Hfe*Rc)/Hie;
13 Ai=-(Rb*Hfe)/(Rb+Hie);
14 Vcc=16; // voltage in volts
15 Vbe=0.6; // voltage in volts

```

```

16 Beta=100; // for transistor
17 Vb=(R2*Vcc)/(R1+R2);
18 Ib=(Vb-Vbe)/(Rb+(1+Beta)*Re);
19 Ic=Beta*Ib;
20 Ie=Ic;
21 re=26/Ie;
22 Zin=(Rb*(Beta*re*10^-3))/(Rb+(Beta*re*10^-3));
23 Zout=Rc;
24 Av1=-(Rc*10^3)/re;
25 Ai1=-(Beta*(Rb*10^3))/((Rb*10^3)+(Beta*re));
26 disp("part 1 -from h-parameter model")
27 disp(Rb,"base resistance (kilo-ohm) = ")
28 disp(zi,"input impedance (kilo-ohm) = ")
29 disp(zo,"ouput impedance (kilo-ohm) = ")
30 disp(Ai,"current gain (unitless) = ")
31 disp(Av,"voltage gain (unitless) = ")
32 disp("part 2 -from re model")
33 disp(Vb,"base voltage (V) = ")
34 disp(Ib,"base curret (mA) = ")
35 disp(Ic,"collector curret (mA) = ")
36 disp(Ie,"emitter curret (mA) = ")
37 disp(re,"resistance = ")
38 disp(Zin,"input impedance (kilo-ohm) = ")
39 disp(Zout,"ouput impedance (kilo-ohm) = ")
40 disp(Ai1,"current gain (unitless) = ")
41 disp(Av1,"voltage gain (unitless) = ")

```

Scilab code Exa 3.3 input impedance output impedance and current gain

```

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

```

```

6 Vee=8; // emitter voltage in volts
7 Vbe=0.6; // base voltage in volts
8 Ie=(Vee-Vbe)/(Re*10^3)
9 re=26*10^-3/Ie;
10 zi=((Re*10^3)*re)/((Re*10^3)+re);
11 zo=Rc;
12 Av=Rc/(re*10^-3);
13 Ai=Ie/Ie;
14 disp(Ie,"emitter current (A) = ")
15 disp(zi,"input impedance (ohm) = ")
16 disp(zo,"output impedance (kilo-ohm) = ")
17 disp(Ai,"current gain (unitless) = ")
18 disp(Av,"voltage gain (unitless) = ")

```

Scilab code Exa 3.4 collector efficiency

```

1 // Example 3.1: determine collector efficiency
2 clc, clear;
3 Vmax=25; // collector emitter voltage in volts
4 Vmin=2.5; // collector emitter voltage in volts
5 eta=(50*((Vmax-Vmin)/(Vmax+Vmin)));
6 disp(eta,"collector efficiency (%) = ")

```

Scilab code Exa 3.5 maximum power output

```

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

```

```

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

```

Scilab code Exa 3.6 power rating of transistor

```

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

```

Scilab code Exa 3.7 power dissipated and efficiency

```

1 // 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
2 clc, clear;
3 alpha=3;//
4 Podc=0.434;//output ac power in watts
5 Icq=140;//current in milli ampere
6 Rl=8;//load resistance in killo ohms
7 Vcq=10;
8 Vcc=Vcq;//
9 Vcemax=18.3;//maximum collector to emitter voltage
   in volts
10 Vcemin=2.5;//minimum collector to emitter voltage in
   volta
11 Icmx=245;//maximum collector current in mili ampere
12 Icmn=25;//minimum collector current in mili ampere
13 Vlrms=(Vcemax-Vcemn)/(2*sqrt(2));//
14 Vlrms=(1/alpha)*Vlrms;//rms value of load voltage
15 ILrms=(Vlrms/Rl)*103;//rms value of load current
16 Pindc=Vcc*Icq*10-3;// ac power developed across the
   load in watts
17 Pd=Pindc-Podc;// power dissipated in watts
18 n=(Podc/Pindc)*100;//efficiency
19 disp(Vcemax,"maximum collector to emitter voltage in
   volts")
20 disp(Vcemn,"minimum collector to emitter voltage in
   volts")
21 disp(Icmx,"maximum collector current in mili ampere
   ")
22 disp(Icmn,"minimum collector current in mili ampere
   ")
23 disp(Vlrms,"rms value of load voltage")
24 disp(ILrms,"rms value of load current in milli
   ampere")
25 disp(Pindc,"ac power developed across the load in
   watts")

```

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

Scilab code Exa 3.8 overall efficiency

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

Scilab code Exa 3.9.a harmonic distortion

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

Scilab code Exa 3.9.b harmonic distortion

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



```

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

```

Scilab code Exa 3.10 harmonic distortion and percentage

```

1 //Exa 3.10
2 clc;
3 clear;
4 close;
5 //given data :
6 //Vs=1.95*sin(400*t);in volt
7 //io=12*sin400*t+1.2*sin800*t+0.9*sin*1200*t+0.4*
  sin1600*t
8 //from current we have
9 V1=12;//in volt
10 V2=1.2;//in volt
11 V3=0.9;//in volt
12 V4=0.4;//in volt
13 //Harmonic distortion of each component is expressed
  as :
14 D2=V2/V1;//unitless
15 D3=V3/V1;//unitless
16 D4=V4/V1;//unitless
17 //Total distortion
18 D=sqrt(D2^2+D3^2+D4^2);//unitless
19 disp(" Total disortion : "+string(D)+" or "+string(D
  *100)+"%");
20 //Total Power
21 disp(" Total Power, P=(1+D2^2)*P1");
22 disp(" Percentage Increase in power because of
  distortion=(P-P1)*100/P1");
23 PowerIncrease=D^2*100;//in %
24 disp(PowerIncrease," Percentage Increase in power = "
  );

```

Scilab code Exa 3.11.a minimum power drain

```
1 // Example 3.11 (i): minimum power drain on the
   power supply
2 clc, clear;
3 P1=10; // power delivered to load in watt
4 eta1=80/100; // output transformer efficiency
5 eta=78.5/100; // efficiency of a class B push pull
   amplifier under optimum condition
6 Pout=P1/eta1;
7 Pin=Pout/eta;
8 disp(Pout,"ac power output of amplifier (W) = ")
9 disp(Pin,"minimum power drain on the power supply (W
   ) = ")
```

Scilab code Exa 3.11.b minimum average power dissipation

```
1 // Example 3.11 (ii): minimum average power
   dissipation
2 P1=10; // power delivered to load in watt
3 eta1=80/100; // output transformer efficiency
4 eta=78.5/100; // efficiency of a class B push pull
   amplifier under optimum condition
5 Pout=P1/eta1;
6 Pin=Pout/eta;
7 Pd=Pin-Pout;
8 Pd1=Pd/2;
9 disp(Pout,"ac power output of amplifier (W) = ")
10 disp(Pin,"minimum power drain on the power supply
   for dc (W) = ")
11 disp(Pd,"minimum average power dissipation (W) = ")
```

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

Scilab code Exa 3.12 power and conversion efficiency

```
1 // Example 3.12 : the percent second harmonic
  distortion
2 clc, clear;
3 Vcc=50; // voltage in volts
4 Vmin=5; // minimum voltage in volts
5 pi=3.142857;
6 Pd=40; // total power dissipation in watt
7 Icmx=Pd/(((2*Vcc)/pi)-((Vcc-Vmin)/2));
8 Pin=(2/pi)*(Vcc*Icmx);
9 Pout=((Icmx/2)*(Vcc-Vmin));
10 eta=(Pout/Pin)*100;
11 disp(Icmx,"maximum collector current (A) = ")
12 disp(Pin,"total power input (W) = ")
13 disp(Pout,"ac power output (W) = ")
14 disp(eta,"conversion efficiency (%) = ")
```

Chapter 4

FIELD EFFECT TRANSISTORS AND MOSFETs

Scilab code Exa 4.1 drain current

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

Scilab code Exa 4.2 drain current

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

Scilab code Exa 4.3 minimum and maximum transconductance curve

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

```

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

```

Scilab code Exa 4.4 drain current and transconductance

```

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

```

Scilab code Exa 4.5 drain resistance

```

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

```

```

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

```

Scilab code Exa 4.6 drain resistance

```

1 // Example 4.6: drain resisitance
2 clc, clear
3 //Given DATA
4 Vdd=10; //in volt
5 ID=0.4; //in mA
6 mu_nCox=20; //in uA/V^2
7 W=100; //in um
8 L=10; //in um
9 Vt=2; //in Volt
10 //Formula : ID=mu_n*Cox*W*(VGS-Vt)^2/(2*L)
11 VGS=sqrt(2*L*ID/(mu_nCox*10^-3*W))+(Vt); //in Volt
12 Vd=VGS; //
13 R=(Vdd-Vd)/ID; // resistance in killo ohms
14 disp(R,"drain resistance in killo ohms is")

```

Scilab code Exa 4.7 drain to source resistance

```

1 // Example 4.7: drain to source resisitance
2 clc, clear
3 //Given DATA
4 Vdd=5; //in volt

```

```

5 knw1=1; //in mA/V^2
6 Vd=0.1; //drain voltage
7 Vt=1; //in Volt
8 Id=Vt*((Vdd-Vt)*Vd- (1/2)*0.01); //drain current in
    milli ampere
9 Rd=(Vdd-Vd)/Id; // resistance in killo ohms
10 Rds= Vd/Id; //resistance in killo ohms
11 disp(Rds,"drain to source resistance in killo ohms
    is")

```

Scilab code Exa 4.8 circuit analyze

```

1 // Example 4.8: Analyse the circuit
2 clc, clear
3 //Given DATA
4 Vdd=10; //in volt
5 ID=0.4; //in mA
6 knw1=1; //in mA/V^2
7 Vg=5; //gate voltage in volys
8 Vt=1; //in Volt
9 Rd=6' //drain resistance in killo ohms
10 Id=0.5; //in mA after solving the qudratic equation
11 Vs= Id*Rd; //source voltage in volts
12 Vd= Vdd-Rd*Id; //drain voltage in volts
13 Vgs= Vg-Rd*Id; //gate to source voltage in volts
14 disp(Vs,"source voltage in volts")
15 disp(Vd,"drain voltage in volts")
16 disp(Vgs,"gate to source voltage in volts")
17 disp(Id,"drain current in milli ampere")
18 disp("As Vd>Vg-Vt the transistor is operating at
    saturation as initially assumed")

```

Scilab code Exa 4.9 drain resistance


```

1 // Example 4.9: drain resisittance
2 clc, clear
3 //Given DATA
4 Vdd=5; //in volt
5 Id=0.5; //in mA
6 knwl=1; //in mA/V^2
7 Vt=-1; //in Volt
8 //Formula :  $ID = \mu_n \cdot C_{ox} \cdot W \cdot (V_{GS} - V_t)^2 / (2 \cdot L)$ 
9 VGS=sqrt((2*Id/knwl))+(Vt); //in Volt
10 Vd=3; //
11 Rd1=Vd/Id; //drain resistance in killo ohms
12 Vdm= Vd-Vt; //saturation mode operation
13 Rd2=Vdm/Id; //drain resistance in killo ohms
14 disp(Rd1," drain resistance in killo ohms is")
15 disp(Rd2," drain resistance in killo ohms is")

```

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

```

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

```

Scilab code Exa 4.11 drain to source resistance

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

Scilab code Exa 4.12 input resistance

```
1 // Example 4.12:input resistance
2 clc, clear
3 //Given DATA
4 Vdd=15; //in volt
5 knwl=0.25; //in mA/V^2
6 Va=50; //voltage
7 Vt=1.5; //in Volt
8 Id=1.06; //drain current in milli ampre
9 Vd= 4.4; //drain oltage in volt
10 Vgs=Vd; //
11 gm=knwl*(Vgs-Vt); //transconductance in mA/V
12 ro=Va/Id; //output resistance in killo ohms
13 Rd=10; //drain resistance in killo ohms
14 Rg=10; //gate resistance in killo ohms
15 Rl=10; //load resistance in killo ohms
16 x=(Rd*Rl)/(Rd+Rl); //
17 Av= -gm*((x*ro)/(x+ro)); //voltage gain
```

```
18 Ii=4.3;//input current in milli ampere
19 Ri= Rg/Ii;//input resistance in mega ohms
20 disp(Ri,"input resistance in mega ohms")
```

Chapter 5

FREQUENCY RESPONSE

Scilab code Exa 5.1 coupling capacitor

```
1 // Example 5.1:COUPLING CAPACITOR
2 clc;
3 clear;
4 close;
5 Rs=10;//series resistance in killo ohms
6 Xc1= Rs/10;//reactance at 20Hz
7 C1=(1/(2*pi*20*Xc1*10^3))*10^6;//CAPACITANCE IN
   MICRO FARAD
8 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

```
1 // Example 5.2:amplifier gain
2 clc;
3 clear;
4 close;
5 f=20;//frequency in hertz
```

```

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

```

Scilab code Exa 5.3 amplifier gain

```

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

```

Scilab code Exa 5.4 amplifier gain

```

1  // Example 5.4: amplifier gain
2  clc;
3  clear;
4  close;
5  f=50; //frequency in hertz
6  Avm=150/0.707; //mid voltage gain
7  fh=20; //lower cut off frequency in hertz

```

```

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

```

Scilab code Exa 5.5 maximum voltage gain

```

1 // Example 5.5:maximum voltage gain
2 clc;
3 clear;
4 close;
5 Avl=100; //voltage gain
6 Avm=Avl/0.708; //MID VOLTAGE GAIN
7 disp(Avm,"maximum voltage gain is")

```

Scilab code Exa 5.6 series capacitance and transfer function

```

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

```

Scilab code Exa 5.7 corner frequency and maximum magnitude asymptote

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

Scilab code Exa 5.8 frequency and bandwidth

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

```

11 fl= (1/(2*pi*ts))*10^-6; //lower frequency in mega
    hertz
12 fh= (1/(2*pi*tp))*10^-6; //upper frequency in mega
    hertz
13 BW=fh-fl; //bandwidth in mega hertz
14 disp(fl,"lower 3 dB frequency in mega hertz")
15 disp(fh,"upper 3 dB frequency in mega hertz")
16 disp(BW,"bandwidth in mega hertz is")

```

Scilab code Exa 5.9 frequency and bandwidth

```

1 // Example 5.9:3-dB frequency and bandwidth
2 clc;
3 clear;
4 close;
5 Cp=1; //PARALLEL capacitance IN PICO FARAD
6 Cs=2; //series capacitance IN micro FARAD
7 rs=1; //series resistance in killo ohms
8 rp=10; //PARALLEL resistance in killo ohms
9 ts= ((rs+rp)*10^3*Cp*10^-12); //time constant
10 tp= ((rs*rp)/(rs+rp))*10^3*Cp*10^-12); //time constant
11 fl= (1/(2*pi*ts))*10^-6; //lower frequency in mega
    hertz
12 fh= (1/(2*pi*tp))*10^-6; //upper frequency in mega
    hertz
13 BW=fh-fl; //bandwidth in mega hertz
14 ts= (rs+rp)*10^3*Cp*10^-12; //open circuit time
    constant
15 tp= ((rs*rp)/(rs+rp))*10^3*Cp*10^-12; //short time
    constant
16 Ts= (rp)/(rs+rp) //midband transfer function
17 TsdB= 20*(log10(Ts)); //midband transfer function in
    dB
18 disp(ts,"open circuit time constant is")
19 disp(tp,"short circuit time constant is ")

```



```

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

```

Scilab code Exa 5.10 CORNER FREQUENCIES AND BANDWIDTH

```

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

```

Scilab code Exa 5.11 LOW FREQUENCY RESPOANSE

```

1 /// Example 5.10:low frequecy response
2 clc;
3 clear;
4 close;
5 Beta=100;//

```

```

6 Rs=1; //series resistance in killo ohms
7 R1=40; // resistance in killo ohms
8 R2=10; // resistance in killo ohms
9 hie=1.1; //in killo ohms
10 x=(R1*R2)/(R1+R2); //
11 Y=(x*hie)/(x+hie); //
12 Rin= Y+Rs; //input resistance in killo ohms
13 C1=10; //capacitance in micro farad
14 fc=(1/(2*pi*Rin*10^3*C1*10^-6)); //CUT OFF FREQUENCY
    OF INPUT RC NETWORK
15 Ce=20; //emitter capacitance in micro farad
16 hic=1100; //in ohms
17 Rth=(x*Rs)/(x+Rs)*10^3; //
18 Rx= (Rth+hic)/(Beta); //
19 Rl=2; //resistance in killo ohms
20 R= (Rx*Rl*10^3)/(Rx+Rl*10^3); //in ohms
21 fc1=(1/(2*pi*R*Ce*10^-6)); //CUT OFF FREQUENCY OF
    bypass RC NETWORK
22 Rl=1.8; //load resistance in killo ohms
23 Rc=4; //collector resistance in killo ohms
24 C2=1; //capacitance in micro farad
25 fc2=(1/(2*pi*(Rl+Rc)*10^3*C2*10^-6)); //CUT OFF
    FREQUENCY OF outPUT RC NETWORK
26 disp(fc,"CUT OFF FREQUENCY OF INPUT RC NETWORK in
    hertz")
27 disp(fc1,"CUT OFF FREQUENCY OF BYPASS RC NETWORK in
    hertz")
28 disp(fc2,"CUT OFF FREQUENCY OF OUTPUT RC NETWORK in
    hertz")

```

Scilab code Exa 5.12 CORNER FREQUENCY AND MAXIMUM GAIN

```

1 // Example 5.12:corner frequency and maximum GAIN
2 clc;
3 clear;

```

```

4  close;
5  Vcc=10; // Colector voltage in volts
6  Beta= 100;
7  Rc=1; // Collector resistance in killo ohms
8  Rs=600; //SERIES RESISTANCE IN OHMS
9  Re=0.2; // in kilo ohms
10 R1= 50; // in kilo ohms
11 R2= 10; // in kilo ohms
12 Vbe=0.7; // Base to emitter voltage in volts
13 C1=1; //capacitance in micro farad
14
15 Vth=Vcc * (R2/(R1+R2)); // vOLTAGE AT BASE
16
17
18 Rth= (R1*R2)/(R1+R2);
19 Ib=((Vcc-Vbe)/((Rth+(1+Beta)*Re)*10^3))*10^5; //in
    micro ampere
20 Icq= Beta*Ib*10^-3; //in milli ampere
21 Vt=26; //volate at room termprature in milli volts
22 gm= (Icq/Vt)*10^3; //transconductance in milli ampere
    per volts
23 rpi= (Beta*Vt*10^-3)/(Icq*10^-3); //resistance
24 Rb=Rth; //base resistance in killo ohms
25 x=(rpi+(1+Beta)*Re*10^3); //
26 y=(Rs+Rb*10^3); //
27 ts=((x*y)/(x+y))*C1*10^-3; //in milli second
28 fl= (1/(2*%pi*ts*10^-3)); //corner frequency in hertz
29 Ri=(x*Rb*10^-3)/(Rb+x*10^-3); //
30 Av= ((gm*10^-3*rpi*Rc*10^3)*Rb*10^3)/((Ri+Rs*10^-3)
    *10^3*(x*10^-3+Rb)*10^3);
31 disp(fl,"corner frequency in hertz is")
32 disp(Av,"maximum gain is")

```

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

```

1 // Example 5.15:TIME CONSTANTS , MIDBAND VOLTAGE
  GAIN AND COERNER FREQUENCIES
2 clc;
3 clear;
4 close;
5 Rl=4; //load resistance in killo ohms
6 Rs=250; //SERIES RESISTANCE IN OHMS
7 rpi= 2; //resistance IN KILLO OHMS
8 Re=0.2; // in kilo ohms
9 C1=2; //capacitance in micro farad
10 C1=50; //capacitance in pico farad
11 ts=(Rs*10-3+rpi)*103*C1*10-3; //open circuit time
  constant in milli second
12 tp=Rl*C1*10-3; //short circuit time constant in
  micro second
13 gm= 6.5 //transconductance in milli ampere per volts
14 Av= (((gm*10-3*rpi*103*Rl*103))/(Rs*10-3+rpi)
  *103)*10-5; //mid voltage gain
15 fl=(1/(2*%pi*ts*10-3)); //lower cut off frequency in
  hertz
16 fh=(1/(2*%pi*tp*10-6))*10-6; //upper cut off
  frequency in mega hertz
17 disp (ts,"open circuit time constant in milli second
  is")
18 disp(tp,"short circuit time constant in micro second
  ")
19 disp(Av,"maximum gain is")
20 disp(fl,"lower cut off frequency in hertz")
21 disp(fh,"upper cut off frequency in mega hertz")

```

Scilab code Exa 5.17 LOW FREQUENCY RESPONSE

```

1 // Example 5.16:frequency response
2 clc;
3 clear;

```

```

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

```

Scilab code Exa 5.18 fB

```

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

```

Scilab code Exa 5.19 BANDWIDTH AND CAPACITANCE

```

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

```

Scilab code Exa 5.20 3 DB FREQUENCY RESPONSE

```

1 // Example 5.19:corner frequency
2 clc;
3 clear;
4 close;
5 Rs=1; //series resistance in killo ohms
6 Rl=3.7; //load resistance in killo ohms
7 Rc=3.7; // Collector resistance in killo ohms
8 R1= 200; // in kilo ohms
9 R2= 200; // in kilo ohms
10 Vbe=0.7; // Base to emitter voltage in volts
11 Rb= (R1*R2)/(R1+R2);
12 rpi=2.5; //resistance in killo ohms
13 Cpi=0.18; //capacitance in pico farad
14 gm=40; //transconductance in milli ampere per volts
15 y=(Rc*R1)/(Rc+R1); //
16 Cmu= Cpi*(1+gm*y); //
17 Cm2=Cmu; //

```

```

18 z=(Rs*rpi)/(Rs+rpi);//
19 R=(Rb*z)/(Rb+z);//
20 C=Cmu+4;//
21 f3db= (1/(2*%pi*R*10^3*C))*10^6;//3-dB frequency in
    mega hertz
22 C1=4;//capacitance in pico farad
23 f3db1= (1/(2*%pi*R*10^3*C1))*10^6;//3-dB frequency
    in mega hertz
24 disp(f3db,"3-dB frequency in mega hertz due to
    miller effect")
25 disp(f3db1,"3-dB frequency in mega hertz")
26 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

```

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

```

```

        pico farad
17 R1= 50; // in kilo ohms
18 R2= 5; // in kilo ohms
19 Rb= (R1*R2)/(R1+R2);
20 rs=1; //in killo ohms
21 x=(Rb*rs)/(Rb+rs); //
22 y=(rpi*x)/(rpi+x); //
23 fh=(1/(2*pi*y*10^3*(Cmu+Cpi)*10^-6)); //3-db upper
        cut off frequency in mega hertz
24 z=(Rb*rpi)/(Rb+rpi); //
25 Avm=(gm*Rld*z)/(z+rs); //
26 disp(fh,"3-db upper cut off frequency in mega hertz
        is")
27 disp(Avm,"MIDBAND GAIN")

```

Scilab code Exa 5.22 MIDBAND GAIN AND UPPER 3DB FREQUENCY

```

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

```



```

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

```

Scilab code Exa 5.23 MIDBAND GAIN AND UPPER 3DB FREQUENCY

```

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

```

```

14 R1= 40; // in kilo ohms
15 R2= 20; // in kilo ohms
16 R3= 27; // in kilo ohms
17 Rb=(R2*R3)/(R2+R3); //
18 g=(rs*rpi)/(rs+rpi); //
19 tp1=((Rb*g)*(Cpi+2*Cmu))/(Rb+g))*10^-9; //in second
20 m=rpi/(1+Beta); //
21 tp2= m*(Cmu+Cpi)*10^-9; //
22 Rc=4.7; //collector resistance in killo ohms
23 Rl=10; //load resistance in killo ohms
24 Rld= (Rc*Rl)/(Rc+Rl); //
25 tp3=Cmu*10^-12*Rld*10^3; //in second
26 fh1=(1/(2*pi*tp1*10^6)); //first 3-db upper cut off
    frequency in mega hertz
27 fh2=(1/(2*pi*tp2*10^6)); //second 3-db upper cut off
    frequency in mega hertz
28 fh3=(1/(2*pi*tp3*10^6)); //third 3-db upper cut off
    frequency in mega hertz
29 Avm= -gm*Rld*(rpi/(rpi+1)); //
30 disp(fh1,"3-db upper cut off frequency in mega hertz
    is")
31 disp(fh2,"second 3-db upper cut off frequency in
    mega hertz")
32 disp(fh3,"third 3-db upper cut off frequency in mega
    hertz")
33 disp(Avm,"MIDBAND GAIN")

```

Scilab code Exa 5.24 UPPER AND LOWER CUT OFF FREQUENCY

```

1 // Example 5.23:corner frequency and bandwidth
2 clc;
3 clear;
4 close;
5 tr=16; //rise time in micro second
6 V=100; //voltage in milli volts

```

```

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

```

Scilab code Exa 5.25 PERCENTAGE TILT

```

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

```

Scilab code Exa 5.26 PERCENTAGE TILT AND LOWEST INPUT FREQUENCY

```

1 // Example 5.25:PERCENTAGE TILT
2 clc;
3 clear;

```

```

4  close;
5  Rc=2; //RESISTANCE IN KILLO OHMS
6  Rl=10; //RESISTANCE IN KILLO OHMS
7  R1=Rc+Rl; //
8  C=10; //capacitance in micro farad
9  fl=(1/(2*%pi*R1*10^3*C*10^-6)); //LOWER CUT -OFF
    FREQUENCY
10 f=100; //frequency in hertz
11 P= (%pi*f1)/f; //
12 p1=0.02
13 f=(%pi*f1)/p1; //
14 disp(P*100,"percentage tilt is")
15 disp(f,"as the input frequency increases the
    percentage tilt decreases")

```

Scilab code Exa 5.27 LOWER AND UPPER CUT OFF FREQUENCY

```

1  // Example 5.26:fh , fl and bandwidth
2  clc;
3  clear;
4  close;
5  fln=25; //in hertz
6  fhn=16; //in kelo hertz
7  n=3; //
8  x=sqrt(2^(1/n)-1); //
9  fl=x*fln; //lower cut off frequency in hertz
10 fh=fhn/x; //upper cut off frequency in hertz
11 BW=fh-fl*10^-3; //bandwidth
12 disp(fl,"lower cut off frequency in hertz")
13 disp(fh,"upper cut off frequency in killo hertz")
14 disp(BW,"bandwidth in killo hertz")

```

Scilab code Exa 5.28 OVERALL BANDWIDTH

```

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

```

Scilab code Exa 5.29 UPPER AND LOWER CUT OFF FREQUENCY

```

1 // Example 5.28:fh , fl
2 clc;
3 clear;
4 close;
5 fln=20; //in hertz
6 fhn=100; //in kelo hertz
7 n=3; //
8 x=sqrt(2^(1/n)-1); //
9 fl=x*fln; //lower cut off frequency in hertz
10 fh=fhn/x; //upper cut off frequency in hertz
11 disp(fl,"lower cut off frequency in hertz")
12 disp(fh,"upper cut off frequency in killo hertz")

```

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

```

1 // Example 5.29:Avm, Fh, Cc

```

```

2  clc;
3  clear;
4  close;
5  mu=70; //
6  rd=44; //resistance in killo ohms
7  gm= mu/(rd); //transconductane in milli ampere per
    volt
8  Rd2=50; //resistance in killo ohms
9  x=(rd*Rd2)/(rd+Rd2); //
10 Av2m= gm*x; //mid frequency gain of second stage
11 Rg=1; //gate resisatnce in mega ohms
12 y= (x*Rg*10^3)/(x+Rg*10^3); //
13 Av1m= -gm*y; //mid frequency gain of first stage
14 Av= Av1m*Av2m; //total gain
15 Req=y; //
16 Csh=200; //capacitance in pico farad
17 fh=(1/(2*%pi*Req*10^3*Csh*10^-9)); //upper cut off
    frequency in killo hertz
18 Ro1=x; //
19 fl=50; //
20 Cc=(1/(2*%pi*fl*(Ro1*10^3+Rg*10^6)))*10^9; //coupling
    capacitance in nano farad
21 disp(Av2m,"mid frequency gain of second stage")
22 disp(fh,"upper cut off frequency in killo hertz")
23 disp(Cc,"coupling capacitance in nano farad")

```

Scilab code Exa 5.31 GAIN OF OVERALL AMPLIFIER

```

1  // Example 5.28:gain
2  clc;
3  clear;
4  close;
5  gm= 10; //transconductane in milli ampere per volt
6  Csh=20; //capacitance in pico farad
7  BW=10; //bandwidth in mega hertz

```

```

8 fhn=10; //in mega hertz
9 n=2; //
10 x=sqrt(2^(1/n)-1); //
11 fh=fhn/x; //lower cut off frequency in mega hertz
12 R=(1/(2*pi*Csh*10^-12*fh*10^6)); //resiatnce in ohms
13 Av1=-gm*R*10^-3; //mid frequency gain of first stage
14 Av2=Av1; //mid frequency gain of second stage
15 Av= Av1*Av2; //total gain
16 Avdb=20*(log10(Av)); //total gain dB
17 disp(Avdb,"total gain in dB is")

```

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

```

1 // Example 5.31:Avm, Fh, Fl
2 clc;
3 clear;
4 close;
5 n=2
6 C=50; //in micro farad
7 Cc=0.1; //in micro farad
8 rd=50; //resis
9 Rs=1; //series resistance in killo ohmstance in killo
   ohms
10 gm= 2; //transconductane in milli ampere per volt
11 Rd=10; //resistance in killo ohms
12 x=(rd*Rd)/(rd+Rd); //
13 Av2m= -gm*x; //mid frequency gain of second stage
14 Rg=1; //gate resiatnce in mega ohms
15 y= (x*Rg*10^3)/(x+Rg*10^3); //
16 Avm= -gm*y; //mid frequency gain of first stage
17 Av= Avm*Av2m; //total gain
18 Avdb=20*(log10(Av)); //
19 Req=y; //
20 Csh=10; //capacitance in pico farad
21 fh=(1/(2*pi*Req*10^3*Csh*10^-6)); //upper cut off

```

```

    frequency in mega hertz
22 Ro1=y;//
23 fl=(1/(2*%pi*Cc*10^-6*Ro1*10^3));//lower cut off
    frequency in hertz
24 x=sqrt(2^(1/n)-1);//
25 fhn=x*fh;//lower cut off frequency in hertz
26 fln=fl/x;//upper cut off frequency in hertz
27 disp(Avdb,"total voltage gain in db")
28 disp(fl,"lower cut off frequency in hertz")
29 disp(fh,"upper cut off frequency in mega hertz")
30 disp(fln,"3 db lower cut off frequency in hertz")
31 disp(fhn,"3 db upper cut off frequency in mega hertz
    ")

```

Scilab code Exa 5.33 MIDBAND VOLTAGE GAIN CUT OFF FREQUENCIES

```

1 // Example 5.32: Avm, Fh, Fl
2 clc;
3 clear;
4 close;
5 n=3
6 Cc=0.005;//in micro farad
7 C=100;//in pico farad
8 rd=7.7;//
9 Rs=1;//series resistance in killo ohmstance in killo
    ohms
10 gm= 25;//transconductane in milli ampere per volt
11 Rd=10;//resistance in killo ohms
12 x=(rd*Rd)/(rd+Rd);//
13 Av2m= -gm*x;//mid frequency gain of second stage
14 Rg=1;//gate resisatnce in mega ohms
15 y= (x*Rg*10^3)/(x+Rg*10^3);//
16 Avm= -gm*y;//mid frequency gain of first stage
17 Av= Avm*Avm*Avm;//total gain
18 Avdb=20*(log10(-Av));//

```



```

19 Req=y;//
20 Csh=100;//capacitance in pico farad
21 fh=(1/(2*%pi*Req*10^3*Csh*10^-9));//upper cut off
    frequency in killo hertz
22 Ro1=y;//
23 fl=(1/(2*%pi*Cc*10^-6*(Ro1*10^3+Rg*10^6)));//lower
    cut off frequency in hertz
24 x=sqrt(2^(1/n)-1);//
25 fhn=x*fh;//lower cut off frequency in hertz
26 fln=fl/x;//upper cut off frequency in hertz
27 disp(Avdb,"total voltage gain in db")
28 disp(fl,"lower cut off frequency in hertz")
29 disp(fh,"upper cut off frequency in killo hertz")
30 disp(fln,"3 db lower cut off frequency in hertz")
31 disp(fhn,"3 db upper cut off frequency in killo
    hertz")

```

Chapter 6

FEEDBACK

Scilab code Exa 6.1 gain

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

Scilab code Exa 6.2 feedback factor

```
1 // Example 6.2; // feedback factor
2 clc;
3 clear;
4 close;
5 a=60; // OPEN LOOP VOLTAGE GAIN IN dB
```

```

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

```

Scilab code Exa 6.3 feedback output

```

1 // Example 6.3; // feedback output
2 clc;
3 clear;
4 close;
5 A= 600; // open voltage gain
6 Af=50; //
7 Beta=( (A/Af)-1)/A; // feedback ratio
8 fop= (Beta*100); //percentage of output voltage which
   is feedback to the input is
9 disp(fop, "percentage of output voltage which is
   feedback to the input is ")

```

Scilab code Exa 6.4 feedback ratio

```

1 // Example 6.3; // feedback ratio
2 clc;
3 clear;
4 close;
5 Vo= 5; // output voltage
6 Vin=0.1; //input voltage without feedback
7 A= Vo/Vin; // Gain without feedback
8 Vin1=0.2; //input voltage with feedback
9 Af= Vo/Vin1; // Gain with feedback
10 Beta=( (A/Af)-1)/A; // feedback ratio
11 disp(Beta, "feedback ration is ")

```

Scilab code Exa 6.5 Change in gain

```
1 // Example 6.5; // Change in gain
2 clc;
3 clear;
4 close;
5 A= 1000; // open loop voltage gain
6 Beta= 0.002; // feedback ratio
7 Af= (A/(1+(Beta*A))); //GAIN WITH FEEDBACK
8 A1= (1-0.15)*A; //new open loop voltage gain
9 Af1= (A1/(1+(Beta*A1))); //GAIN WITH FEEDBACK
10 dA=((Af-Af1)/Af)*100; // Change in overall gain in
    percentage
11 disp(dA,"Change in overall gain in percentage is")
```

Scilab code Exa 6.6 open loop voltage gain

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

Scilab code Exa 6.7 open loop voltage gain and negative feedback

```

1 // Example 6.7;// open loop voltage gain & negative
  feedback
2 clc;
3 clear;
4 close;
5 Af= 100;//GAIN WITH FEEDBACK
6 dAf=0.1/100;// OPEN LOOP VOLTAGE GAIN
7 dA= 10/100;// open voltage gain
8 BetaA=(dA/dAf)-1;// feedback factor
9 A=Af*(1+BetaA);//open loop voltage gain
10 NF= Af/A;//amount of negative feedback
11 disp(A,"open loop voltage gain is")
12 disp(NF,"amount of negative feedback is")

```

Scilab code Exa 6.8 INPUT VOLTAGE AND OUTPUT VOLTAGE

```

1 // Example 6.8;// GAIN,INPUT VOLTAGE AND OUTPUT
  VOLTAGE
2 clc;
3 clear;
4 close;
5 Vs=10;//output voltage in milli volts
6 Vi= 0.01;//input voltage in volts
7 A=200;//amplifier gain without feedback
8 D=0.1;//distortion without feedback
9 Df=0.01;//distortion with feedback
10 Beta=( (D/Df)-1)/A;// feedback ratio
11 fop= (Beta*100);//percentage of output voltage which
  is feedback to the input is
12 Af= (A/(1+(Beta*A)));//GAIN WITH FEEDBACK
13 Vo= Af*Vs*10^-3;//new output volate in volts
14 Vin= (Vi +(-Beta*Vo))*10^3;//new input voltage in
  milli volts
15 disp(Af,"gain with feedback is")
16 disp(Vo,"new output volate in volts")

```

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

Scilab code Exa 6.9 distortion AND close loop gain

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

Scilab code Exa 6.10 input and output impedance

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

```

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

```

Scilab code Exa 6.11 feedback factor and Change in gain

```

1 // Example 6.11;// feedback factor and Change in
  gain
2 clc;
3 clear;
4 close;
5 Zi=1;//input impedance without feedback in kiilo
  ohms
6 Zo=10;//output impedance without feedback in kiilo
  ohms
7 Zof=1;//output impedance with feedback in killo ohms
8 A= 1000;// open loop voltage gain
9 Beta=( (Zo/Zof)-1)/A;// feedback ratio
10 BetaA= Beta*A;//feedback factor
11 A1= (1-0.1)*A;//new open loop voltage gain
12 Af=100;//FEEDBACK
13 Af1= (A1/(1+(Beta*A1)));//GAIN WITH FEEDBACL
14 dA=((Af-Af1)/Af)*100;// Change in overall gain in
  percentage
15 disp(BetaA,"feedback factor is")
16 disp(dA,"Change in overall gain in percentage is")

```

Scilab code Exa 6.12 gain and frequency

```
1 // Example 6.12; // Avf, Fhf, Flf
2 clc;
3 clear;
4 close;
5 Fh=20; //upper cutoff frequency in killo hertz
   without feedback
6 Fl=30; //upper cutoff frequency in hertz without
   feedback
7 Av= 50000; // open loop voltage gain
8 Beta=5*10^-5; // feedback ratio
9 Avf= (Av/(1+(Beta*Av))); //GAIN WITH FEEDBACK
10 Fhf=Fh*(1+Av*Beta); //upper cutoff frequency with
   feedback in killo hertz
11 Flf=Fl/(1+Av*Beta); //lower cutoff frequency with
   feedback in hertz
12 disp(Fhf, "upper cutoff frequency with feedback in
   killo hertz")
13 disp(Flf, "lower cutoff frequency with feedback in
   hertz")
```

Scilab code Exa 6.13 feedback factor and bandwidth

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



```

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

```

Scilab code Exa 6.14 voltage gain and input and output resistance

```

1 // Example 6.14; //voltage gain ,input & output
    resistance
2 clc;
3 clear;
4 close;
5 A= 500; // open voltage gain
6 Beta=0.01; // feedback ratio
7 Ri=3; //input resistance without feedback in kiilo
    ohms
8 Ro=20; //output resistance without feedback in kiilo
    ohms
9 Af=(A/(1+A*Beta)); //Voltage gain is
10 Rif= (1+A*Beta)*Ri; //input RESISTANCE with feedback
    in kiilo ohms
11 Rof=(Ro/(1+Beta*A)); //output resistance with
    feedback in killo ohms
12 disp(Rif,"input resistance with feedback in kiilo
    ohms is ")
13 disp(Rof,"output resistance with feedback in killo
    ohms is ")

```

Scilab code Exa 6.15 INPUT IMPEDANCE

```

1 // Example 6.15; //INPUT IMPEDANCE
2 clc;
3 clear;

```

```

4  close;
5  Beta=100; //gain
6  R1=18.6; //load resistance in killo ohms
7  Re=9.3; //emitter resistance in killo ohms
8  Vbe=0.7; //
9  Vcc=10; //collector voltage in volts
10 R1=10; //resistance in killo ohms
11 R2=10; //resistance in killo ohms
12 V2= Vcc*(R2/(R1+R2)); // voltage at resistor R2
13 Ve=V2-Vbe; //voltage at emitter
14 Ie=Ve/Re; // Emitter current in milli ampere
15 re=(25/Ie); //AC emitter resistance
16 Re=(R1*Re)/(R1+Re); //effective emitter resistance in
    killo ohms
17 Zib=Beta*(Re*10^3+re)*10^-3; //INPUT IMPEDANCE TO THE
    BASE IN KILLO OHMS
18 x=(R1*R2)/(R1+R2); //resistance in killo ohms
19 Zi=(Zib*x)/(Zib+x); //input impedance of the emitter
    follower in killo ohms
20 disp(Zi,"input impedance of the emitter follower in
    killo ohms is")

```

Scilab code Exa 6.16 gain

```

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

```

```

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

```

Scilab code Exa 6.17 gain

```

1 // Example 6.17; // gain
2 clc;
3 clear;
4 close;
5 R1=1.8; //resistance in killo ohms
6 R2=0.2; //resistance in killo ohms
7 Beta= (R2/(R1+R2)); //feedback factor
8 A=100000; //gain without feedback
9 Af1=(A/(1+A*Beta)); //gain with feedback
10 Af=(1/Beta); //AS A*Beta>>1
11 disp(Af," gain with feedback AS A*Beta>>1 is")

```

Scilab code Exa 6.18 voltage gain and resistance

```

1 // Example 6.18; //Av, Rif ,Avf, Rof
2 clc;
3 clear;
4 close;
5 Rs=600; //Internal resistance in ohms
6 Rl=2; //Load resistance in killo ohms'
7 Rb=40; //base resistance in killo ohms
8 //H Paramters are
9 hie=5; //in killo ohms
10 hre=80;
11 hfe=80;
12 RL1=(Rb*Rl)/(Rb+Rl); //load resistance in killo ohms

```

```

13 Av=(-(hfe*(Rl1*10^3/hie*10^3)))*10^-6; // Voltage
    Gain
14 x=(Rb*10^3/(1-Av)); //
15 Rif= (hie*10^3*x)/(hie*10^3+x) //input resistance
    with feedback
16 Avf=(Av*Rif)/(Rif+Rs); // Overall Voltage gain
17 Rof=((Rb*10^3*(Rs+hie*10^3))/(Rs*hfe))*10^-3; //
    output resistance with feedback
18 Rof1=(Rof*Rl)/(Rof+Rl); // output resistance with
    feedback in killo ohms
19 disp(Av,"Voltage Gain is")
20 disp(Rif,"input resistance with feedback in ohms is"
    )
21 disp(Avf,"Overall Voltage gain is")
22 disp(Rof1,"output resistance with feedback in killo
    ohms")

```

Scilab code Exa 6.19 loop gain

```

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

```

```

16 Av=(-(hfe*(R1*10^3/Rif*10^3)))*10^-6; // Voltage Gain
17 BetaA= Beta*A; //loop gain
18 BetaAd= 20*(log10(-BetaA)); //loop gain in dB
19 disp(A," Voltage Gain is")
20 disp(Beta," Gain is")
21 disp(Rif,"input resistance with feedback in killo
      ohms is")
22 disp(Av," Voltage gain with feedback is")
23 disp(BetaAd,"loop gain in dB is")

```

Scilab code Exa 6.20 voltage gain

```

1 // Example 6.20; // voltage gain
2 clc;
3 clear;
4 close;
5 re=7.5; //A.C. Resistance
6 R1=470; //resistance in ohms
7 Rc=2.2; // resistance in killo ohms
8 Re=510; //emitter resistance in ohms
9 //H Paramters are
10 hie=900; //in ohms
11 hfe=120;
12 A=-(hfe)/(hie+Re); //gain without feedback
13 Beta=-Re; //gain
14 GF= (1+A*Beta); //gain factor
15 Af=A/(GF); //GAIN WITH FEEDBACK
16 Avf= Af*Rc*10^3; //voltage gain with feedback
17 Av= -(Rc*10^3/re); //voltage gain without feedback
18 disp(Avf," voltage gain with feedback is")
19 disp(Av," voltage gain without feedback is")

```

Scilab code Exa 6.21 change in overall gain

```

1 // Example 6.21;// change in overall gain
2 clc;
3 clear;
4 close;
5 Beta=0.01;//feedback
6 Ad= 60;//gain in dB
7 A= 10^(Ad/20);//gain
8 dA= 11;// open voltage gain
9 dAf= (1/(1+Beta*A))*dA;//GAIN WITH FEEDBACK
10 disp(dAf,"change in overall gain is in percentage")
11 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 impedance with feedback

```

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

```

Scilab code Exa 6.23 feedback factor and change in overall gain

```

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

```

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

```

1 // Example 6.24;// feedback fration ,overall voltage
  gain and output voltage
2 clc;
3 clear;
4 close;
5 A=5000;//gain wtihout feedback
6 R1=1;//resistance in killo ohms
7 R2=9;//resistance in killo ohms
8 Beta= R1/(R1+R2);//feedback fraction
9 Afb=round(A/(1+Beta*A));//overall gain
10 Vs=2;//input voltage without feedback in milli volts
11 Vo= round(Afb*Vs);//output voltage with feedback in
  milli volts
12 disp(Beta,"feedback fraction is")
13 disp(Afb,"overall voltage gain")
14 disp(Vo,"output voltage with feedback in milli volts
  ")

```

Scilab code Exa 6.25 overall gain and impedance

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

Scilab code Exa 6.26 gain


```

1 // Example 6.26;// Gain
2 clc;
3 clear;
4 close;
5 a=60;// OPEN LOOP VOLTAGE GAIN IN dB
6 A= 10^(a/20);// open voltage gain
7 Beta=0.009;// feedback ratio
8 Af= (A/(1+(Beta*A)));//GAIN WITH FEEDBACK
9 AfdB= 20*(log10(Af));//gain with feedback in dB
10 disp(AfdB,"gain with feedback in dB is")

```

Scilab code Exa 6.27 reduction in distortion

```

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

```

Scilab code Exa 6.28 feedback and impedance

```

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

```

```

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

```

Scilab code Exa 6.29 bandwidth

```

1 // Example 6.29; //bandwidth
2 clc;
3 clear;
4 close;
5 F2=16; //upper cutoff frequency in killo hertz
    without feedback
6 F1=40; //upper cutoff frequency in hertz without
    feedback
7 A= 800; // open loop voltage gain
8 Beta=0.02; // feedback ratio
9 Afb= (A/(1+(Beta*A))); //GAIN WITH FEEDBACK
10 F2f=F2*(1+A*Beta); //upper cutoff frequency with
    feedback in killo hertz
11 F1f=F1/(1+A*Beta)*10^-3; //lower cutoff frequency
    with feedback in killo hertz
12 Bw=F2-F1*10^-3; //bandwidth without feedback in
    killo hertz
13 Bwf=round(F2f-F1f); //bandwidth with feedback in
    killo hertz
14 disp(Bw,"bandwidth without feedback in killo hertz")

```

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

Scilab code Exa 6.30 bandwidth

```
1 // Example 6.30;//bandwidth
2 clc;
3 clear;
4 close;
5 BW=10;//bandwidth without feedback in killo hertz
6 A= 100;// open loop voltage gain
7 Beta=0.1;// feedback ratio
8 Afb= (A/(1+(Beta*A)));//GAIN WITH FEEDBACK
9 Bwf=round(BW*(1+Beta*A));//bandwidth with feedback
   in killo hertz
10 disp(Afb,"feedback gain")
11 disp(Bwf,"bandwidth with feedback in killo hertz")
```

Scilab code Exa 6.31 gain and harmonic distortion

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

Scilab code Exa 6.32 pole frequency

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

Chapter 7

OSCILLATORS

Scilab code Exa 7.1 oscillation frequency

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

Scilab code Exa 7.2 tuned capacitance range of tuned circuit

```
1 // Example 7.2:tuned capacitance range of tuned
    circuit
2 clc;
3 clear;
4 close;
5 L=100; //INDUCTANCE of tuned circuit in micro henry
```

```

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

```

Scilab code Exa 7.3 TRANSFORMER WINDING RATIO

```

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

```

Scilab code Exa 7.4 oscillation frequency

```

1 // Example 7.4:oscillation frequency
2 clc;
3 clear;
4 close;
5 C1=0.005; //capacitance of tunned circuit in micro
    farad

```

```

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

```

Scilab code Exa 7.5 oscillation frequency

```

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

```

Scilab code Exa 7.6 tuned capacitance and inductance of tuned circuit

```

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

```

```

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

```

Scilab code Exa 7.7 minimum gain and emitter resistance

```

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

```

Scilab code Exa 7.8 tunned capacitance


```

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

```

Scilab code Exa 7.9 oscillation frequency

```

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

```

Scilab code Exa 7.10 oscillation frequency

```

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

```

```

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

```

Scilab code Exa 7.11 feedback ratio

```

1 // Example 7.11:feedback ratio
2 clc;
3 clear;
4 close;
5 Af=40; //gain wtih feedback
6 Vi=2.4; //input voltage
7 Vif=0.1; //input voltage with feedback
8 A= Af*(Vi/Vif); //gain without feedback
9 Beta= (1-(A/Af))/A; //feedback ratio
10 disp(Beta,"feedback ratio is")

```

Scilab code Exa 7.12 resonant frequency

```

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

```

```

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

```

Scilab code Exa 7.13 quality factor

```

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

```

Scilab code Exa 7.14 resonant frequency

```

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

```

```

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

```

Scilab code Exa 7.15 percentage change and quality factor

```

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

```

```

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

```

Scilab code Exa 7.16 oscillation frequency

```

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

```

Scilab code Exa 7.17 resonant frequency

```

1 // Example 7.16:resonant frequency
2 clc;
3 clear;

```

```

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

```

Scilab code Exa 7.18 oscillation frequency

```

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

```

Scilab code Exa 7.19 scillation frequency

```

1 // Example 7.19:oscillation frequency
2 clc;

```

```

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

```

Scilab code Exa 7.20 oscillation frequency

```

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

```

Scilab code Exa 7.21 oscillation frequency

```

1 // Example 7.21:oscillation frequency
2 clc;
3 clear;

```

```

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

```

Scilab code Exa 7.22 oscillation frequency

```

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

```

Scilab code Exa 7.23 Design R C phase shift oscillator

```

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

```



```

13 Rf1=Av*R1;//resistance in killo ohms
14 Rf2=180;//standard resistance in killo ohms
15 R3=Rf2;//
16 R=R1;//
17 C=(1/(2*%pi*R*10^3*fo*10^3*sqrt(6)))*10^6;//
    capacitance in micro farad
18 disp(R,"Resistance for the R-C Phase shift
    oscillator in kilo ohms is")
19 disp(R3,"Resistance for the R-C Phase shift
    oscillator in kilo ohms is")
20 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

```

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

```

Scilab code Exa 7.25 oscillations and minimum gain

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

Scilab code Exa 7.26 design wein bridge oscillator

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

```
15 disp(A,"amplifier gain is")
16 disp(R,"resistance in killo ohms")
17 disp(R3,"resistance in killo ohms")
18 disp(C,"CAPACITANCE IN NANO FARAD")
19 disp("this is name as example 7.27 in the book" )
```

Scilab code Exa 7.27 oscillations and output frequency

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

Scilab code Exa 7.29 design wein bridge oscillator

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

```

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

```

Scilab code Exa 7.32 design BJT R C Phase shift oscillator

```

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

```

```

21 Vb= (Vbe+Ie*Re); //voltage at base
22 R2=R; //
23 I2=Vb/R2; // in mA
24 V2=(Vcc-R2*I2); //voltage drop across R2
25 IR1= (I2+(1/100)); //CURRENT ACROOS R1
26 R1= V2/(IR1); //
27 disp(Re, "Emitter resistance in killo ohms is")
28 disp(Rc, "collector resistance in killo ohms is")
29 disp(R, " resistance in killo ohms is")
30 disp(C, "Capacitance in pico farad is")
31 disp(R3, " resistance(R3) in killo ohms is")
32 disp(R2, " resistance(R2) in killo ohms is")
33 disp(R1, " resistance(R1) in killo ohms is")

```

Scilab code Exa 7.33 design phase shift oscillator

```

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

```

Scilab code Exa 7.34 components of wein bridge oscialltor

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

Scilab code Exa 7.35 series and parallel resonant frequencies

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

```

10 fp=round(((1/(2*pi))*sqrt((1+Cs/Cp)/(Ls*Cs*10^-12))
    )*10^-3); //parallel tuned frequency in killo
    hertz
11 Pc= ((fp-fs)/fs)*100; //percentage by which series
    resonant frequency exceeds the parallel resonant
    frequency
12 Qs= round((2*pi*fs*10^3*Ls)/(Rs*10^3)); //quality
    factor with series resonant frequency
13 Qp= round((2*pi*fp*10^3*Ls)/(Rs*10^3)); //quality
    factor with paralled resonant frequency
14 disp(fs,"series tuned frequency in killo hertz is")
15 disp(fp,"parallel tuned frequency in killo hertz is
    ")
16 disp(Qs,"quality factor with series resonant
    frequency is")
17 disp(Qp,"quality factor with paralled resonant
    frequency is")

```
