

Scilab Textbook Companion for  
A Textbook of Electronic Circuits  
by R. S. Sedha<sup>1</sup>

Created by  
Neelam Ramchandra Jadhav  
pursuing B.E (EXTC)  
Others  
Anjuman-I-Islam's kalsekar Technical campus  
College Teacher  
Chaya  
Cross-Checked by  
Not Applicable

August 4, 2017

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

# Book Description

**Title:** A Textbook of Electronic Circuits

**Author:** R. S. Sedha

**Publisher:** S. Chand And Company

**Edition:** 2

**Year:** 2009

**ISBN:** 9788121928038

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
3 SEMICONDUCTORS	5
5 PN JUNCTION DIODE	16
7 SPECIAL PURPOSE DIODES AND OPTO ELECTRONIC DEVICES	23
8 BIPOLAR JUNCTION TRANSISTORS	28
9 BJT CHARACTERISTICS	34
10 BJT LOW AND HIGH FREQUENCY MODELS	35
11 BJT LOW AND HIGH FREQUENCY MODELS	36
12 THYRISTORS	39
13 PASSIVE CIRCUITS DEVICES	42
16 PN JUNCTION DIODE APPLICATIONS RECTIFIERS AND FILTERS	45

<b>17 CONTROLLED RECTIFIERS</b>	<b>52</b>
<b>18 BJT BIASING AND STABILISATION</b>	<b>56</b>
<b>19 SINGLE STAGE BJT AMPLIFIERS</b>	<b>75</b>
<b>20 HYBRID PARAMETERS</b>	<b>86</b>
<b>21 MULTISTAGE BJT AMPLIFIERS</b>	<b>93</b>
<b>22 FET AMPLIFIERS</b>	<b>100</b>
<b>23 AMPLIFIERS WITH COMPOUND CONFIGURATION</b>	<b>110</b>
<b>24 FREQUENCY RESPONSE OF BJT AND JFET AMPLIFIERS</b>	<b>118</b>
<b>25 LARGE SIGNAL OR POWER AMPLIFIERS</b>	<b>123</b>
<b>26 TUNED AMPLIFIERS</b>	<b>130</b>
<b>27 FEEDBACK AMPLIFIERS</b>	<b>133</b>
<b>28 SINUSOIDAL OSCILLATORS</b>	<b>141</b>
<b>29 NON SINUSOIDAL OSCILLATORS</b>	<b>147</b>
<b>30 LINEAR WAVE SHAPING CIRCUIT</b>	<b>154</b>
<b>31 TIME BASE CIRCUIT</b>	<b>156</b>
<b>32 OPERATIONAL AMPLIFIERS</b>	<b>158</b>
<b>33 OP AMP APPLICATION</b>	<b>164</b>
<b>34 REUGULATED POWER SUPPLIES</b>	<b>166</b>

# List of Scilab Codes

Exa 3.1	length of wire and current density . . . . .	5
Exa 3.2	charge density of free electrons current den- sity current flowing in the wire and electron drift velocity . . . . .	5
Exa 3.3	mobility and relaxation time of electrons . .	6
Exa 3.4	intrinsic conductivity . . . . .	6
Exa 3.5	intrinsic conductivity . . . . .	7
Exa 3.6	concentration of free electrons and drift ve- locity . . . . .	7
Exa 3.7	intrinsic carrier concentration . . . . .	8
Exa 3.8	conductivity . . . . .	9
Exa 3.9	donor concentration . . . . .	9
Exa 3.10	concentration of electrons and holes . . . . .	9
Exa 3.11	minority electron and hole density . . . . .	10
Exa 3.12	length . . . . .	10
Exa 3.13	concentration of holes and electrons . . . . .	11
Exa 3.14	resistivity of germanium sample . . . . .	11
Exa 3.15	resistivity of intrinsic silicon . . . . .	12
Exa 3.16	conductivity of silicon . . . . .	13
Exa 3.17	diffusion coefficients of holes and electrons .	13
Exa 3.18	electron mobility . . . . .	14
Exa 3.19	conduction electrons . . . . .	14
Exa 3.20	number of electrons . . . . .	14
Exa 3.21	mobility and density of charge carrier . . . .	15
Exa 3.22	resistivity . . . . .	15
Exa 5.1	Current . . . . .	16
Exa 5.2	find current . . . . .	16
Exa 5.3	value of n . . . . .	17

Exa 5.4	saturation current . . . . .	17
Exa 5.5	value of VF for the device . . . . .	17
Exa 5.8	dc current and PDmax . . . . .	18
Exa 5.9	voltage drop and current . . . . .	18
Exa 5.10	VD VR I . . . . .	18
Exa 5.11	current . . . . .	19
Exa 5.12	voltage across resistor and current . . . . .	19
Exa 5.13	total current . . . . .	19
Exa 5.14	total current . . . . .	20
Exa 5.15	output voltage . . . . .	20
Exa 5.16	waveform of voltage . . . . .	21
Exa 7.1	value of Izm . . . . .	23
Exa 7.2	maximum power dissipation . . . . .	23
Exa 7.3	resistance of device . . . . .	24
Exa 7.4	terminal voltage . . . . .	24
Exa 7.5	tuning range . . . . .	24
Exa 7.6	frequency of 5th harmonic . . . . .	25
Exa 7.7	resistor . . . . .	25
Exa 7.8	minimum and maximum value of current . . . . .	26
Exa 7.9	Imin and Imax . . . . .	26
Exa 7.10	resistance and current . . . . .	27
Exa 8.1	base current . . . . .	28
Exa 8.2	current gain . . . . .	28
Exa 8.3	base current . . . . .	29
Exa 8.4	IC and IB . . . . .	29
Exa 8.5	alpha and beta . . . . .	29
Exa 8.6	emitter current . . . . .	30
Exa 8.7	current . . . . .	30
Exa 8.8	IB and IE . . . . .	30
Exa 8.9	IC and IE . . . . .	31
Exa 8.10	IC and IB . . . . .	31
Exa 8.11	beta emitter current and new value of beta . . . . .	31
Exa 8.12	collector and emitter current . . . . .	32
Exa 8.13	collector current . . . . .	32
Exa 9.1	PDmax . . . . .	34
Exa 10.1	hybrid pi parameters . . . . .	35
Exa 11.1	drain current . . . . .	36
Exa 11.2	transconductance curve . . . . .	37

Exa 11.4	DRAIN CURRENT AND TRANSCONDUCTANCE . . . . .	37
Exa 11.5	value og ID . . . . .	38
Exa 12.1	destroy the device or not . . . . .	39
Exa 12.2	max allowable duration . . . . .	39
Exa 12.3	voltage . . . . .	40
Exa 12.4	intrinsic stand off ratio and peak point voltage	40
Exa 12.5	rB1 and rB2 . . . . .	40
Exa 13.4	tolerance . . . . .	42
Exa 13.5	coil inductance . . . . .	43
Exa 13.6	coefficient of Coupling . . . . .	43
Exa 13.7	Q factor of coil . . . . .	43
Exa 13.8	capacitance . . . . .	44
Exa 13.9	thickness of dielectric . . . . .	44
Exa 16.1	dc output voltage and PIV . . . . .	45
Exa 16.2	dc load current . . . . .	45
Exa 16.3	maximum and average power . . . . .	46
Exa 16.4	maximum ac voltage . . . . .	47
Exa 16.5	dc output voltage . . . . .	47
Exa 16.6	dc output voltage and PIV and output frequency . . . . .	47
Exa 16.7	dc output voltage PIV and rectification efficiency . . . . .	48
Exa 16.8	load resistor dc load voltage and PIV . . . . .	48
Exa 16.9	inductance . . . . .	49
Exa 16.10	capacitance . . . . .	49
Exa 16.11	size of capacitor . . . . .	50
Exa 16.12	ripple facctor . . . . .	50
Exa 16.13	Vdc peak and average current and average power delivered . . . . .	50
Exa 17.1	angular firing required . . . . .	52
Exa 17.2	power . . . . .	53
Exa 17.3	voltage . . . . .	53
Exa 17.4	resistance . . . . .	54
Exa 17.5	chopper duty cycle and chopping frequency	54
Exa 17.6	dc output voltage . . . . .	54
Exa 18.1	sturation current and cutoff voltage . . . . .	56
Exa 18.2	upper and lower ends of load line . . . . .	57



Exa 18.3	base and collector current and VCE . . . . .	58
Exa 18.4	RB and VCE . . . . .	59
Exa 18.5	voltage and current . . . . .	60
Exa 18.6	find Ic and Vce . . . . .	60
Exa 18.7	load line . . . . .	61
Exa 18.9	current voltage and stability factor . . . . .	63
Exa 18.10	Q point . . . . .	63
Exa 18.11	IB IC AND IE . . . . .	64
Exa 18.12	possible causes . . . . .	64
Exa 18.13	find R1 . . . . .	65
Exa 18.14	base resistance . . . . .	66
Exa 18.15	dc bias current and voltage . . . . .	66
Exa 18.16	current and voltage . . . . .	67
Exa 18.17	OPERATING POINT . . . . .	67
Exa 18.18	R1 and RC . . . . .	68
Exa 18.19	IE and VCE . . . . .	69
Exa 18.20	base current . . . . .	69
Exa 18.21	change in collector current . . . . .	70
Exa 18.24	value of resistors . . . . .	70
Exa 18.25	CURRENT AND VOLTAGE . . . . .	71
Exa 18.26	change in Q point . . . . .	72
Exa 18.27	VOLTAGE AND CURRENT . . . . .	73
Exa 18.28	Quiescent points . . . . .	73
Exa 19.1	resistance and voltage gain . . . . .	75
Exa 19.2	current and gain . . . . .	76
Exa 19.3	resistance and gain . . . . .	76
Exa 19.4	voltage gain and resistance . . . . .	77
Exa 19.5	voltage and impedance . . . . .	78
Exa 19.6	output voltage and output gain . . . . .	79
Exa 19.7	voltage and impedance . . . . .	80
Exa 19.8	Av Ri Ro and Avs . . . . .	80
Exa 19.9	GAIN VOLTAGE AND RESISTANCE . . . . .	81
Exa 19.10	resistance voltage gain current gain power gain . . . . .	83
Exa 19.11	VOLTAGE GAIN . . . . .	83
Exa 19.12	resistance and voltage gain . . . . .	84
Exa 19.13	resistance and voltage . . . . .	85
Exa 20.2	Impedance voltage and current gain . . . . .	86
Exa 20.3	impedance current and voltage gain . . . . .	87

Exa 20.4	voltage gain and resistance . . . . .	87
Exa 20.5	resistance voltage and current gain . . . . .	88
Exa 20.6	resistance voltage and current gain . . . . .	88
Exa 20.7	resistance voltage and current gain . . . . .	89
Exa 20.8	voltage and impedance . . . . .	90
Exa 20.9	resistance voltage and current gain . . . . .	91
Exa 20.10	hfb and hfc . . . . .	91
Exa 20.11	gain and input resistance . . . . .	92
Exa 21.1	total voltage gain . . . . .	93
Exa 21.2	voltage gain and input voltage of 2nd stage	93
Exa 21.3	input resistance output resistance current and voltage gain . . . . .	94
Exa 21.4	voltage gain . . . . .	95
Exa 21.5	cutoff frequency and voltage gain . . . . .	96
Exa 21.6	individual stage gains and voltage gain . . .	96
Exa 21.7	voltage gain . . . . .	97
Exa 21.8	collector current VCE and ac voltage gain .	98
Exa 21.9	gain emitter diode resistance . . . . .	99
Exa 22.1	vdc vgs . . . . .	100
Exa 22.2	R1 . . . . .	100
Exa 22.3	RS and RD . . . . .	101
Exa 22.5	RD and RS . . . . .	102
Exa 22.6	self bias operation point . . . . .	102
Exa 22.7	VGS and VDS . . . . .	102
Exa 22.8	voltage gain . . . . .	103
Exa 22.9	voltage gain . . . . .	103
Exa 22.10	voltage gain . . . . .	104
Exa 22.11	voltage gain . . . . .	104
Exa 22.12	voltage gain . . . . .	105
Exa 22.13	rms output voltage . . . . .	105
Exa 22.14	voltage gain . . . . .	105
Exa 22.15	voltage gain . . . . .	106
Exa 22.16	voltage gain and input output resistance . .	106
Exa 22.17	voltage gain and resistance . . . . .	107
Exa 22.18	voltage gain and input resistance . . . . .	107
Exa 22.19	output resistance . . . . .	108
Exa 22.20	input resistance and ac voltage gain . . . . .	108
Exa 23.1	voltage gain and impedance . . . . .	110

Exa 23.3	voltage gain . . . . .	111
Exa 23.4	current gain . . . . .	112
Exa 23.5	CURRENT GAIN . . . . .	112
Exa 23.6	VE2 IE2 voltage gain . . . . .	112
Exa 23.7	zmatrix . . . . .	113
Exa 23.8	dc bias currents and voltages . . . . .	113
Exa 23.9	load current and output voltage . . . . .	114
Exa 23.10	calculate the value of constant current . . . . .	114
Exa 23.11	current . . . . .	115
Exa 23.12	current . . . . .	115
Exa 23.13	value of current . . . . .	115
Exa 23.14	dc voltage and current . . . . .	116
Exa 23.15	IC AV VO1 . . . . .	116
Exa 23.16	common mode voltage gain . . . . .	117
Exa 24.1	power gain . . . . .	118
Exa 24.2	power gain . . . . .	118
Exa 24.3	power gain . . . . .	119
Exa 24.4	power gain . . . . .	119
Exa 24.5	gain . . . . .	119
Exa 24.8	frequency response . . . . .	119
Exa 24.9	FREQUENCY AND PLOT . . . . .	120
Exa 25.1	collector current and Vce . . . . .	123
Exa 25.2	COMPLIANCE . . . . .	124
Exa 25.3	voltage gain and power gain . . . . .	124
Exa 25.4	collector efficiency and power rating of transistor . . . . .	125
Exa 25.5	ac power . . . . .	125
Exa 25.6	power dissipated . . . . .	125
Exa 25.7	power and efficiency . . . . .	126
Exa 25.8	resistance . . . . .	127
Exa 25.9	turns ratio . . . . .	127
Exa 25.10	max power . . . . .	127
Exa 25.11	ac output power ICQ turns ratio . . . . .	127
Exa 25.12	power . . . . .	128
Exa 25.13	power . . . . .	128
Exa 25.14	PinDC PoAC . . . . .	129
Exa 26.1	frequency . . . . .	130
Exa 26.2	frequency and impedance . . . . .	130

Exa 26.3	bandwidth . . . . .	131
Exa 26.4	Q factor . . . . .	131
Exa 26.5	Q factor . . . . .	131
Exa 26.6	impedance . . . . .	132
Exa 27.1	voltage gain . . . . .	133
Exa 27.2	fraction of output . . . . .	133
Exa 27.3	feedback . . . . .	134
Exa 27.4	voltage gain and beta . . . . .	134
Exa 27.5	beta . . . . .	134
Exa 27.6	beta . . . . .	135
Exa 27.7	change in closed loop gain . . . . .	135
Exa 27.8	values of AV and beta . . . . .	135
Exa 27.9	gain and beta . . . . .	136
Exa 27.10	bw . . . . .	136
Exa 27.11	frequency . . . . .	137
Exa 27.12	gain and distortion gain . . . . .	137
Exa 27.13	beta and gain . . . . .	138
Exa 27.14	voltage gain and resistance . . . . .	138
Exa 27.15	voltage gain and resistance . . . . .	138
Exa 27.16	gain and resistance . . . . .	139
Exa 28.1	inductance . . . . .	141
Exa 28.2	frequency . . . . .	141
Exa 28.3	frequency . . . . .	142
Exa 28.4	frequency . . . . .	142
Exa 28.5	frequency . . . . .	142
Exa 28.6	capacitance . . . . .	143
Exa 28.7	capacitance . . . . .	143
Exa 28.8	c1 and c2 . . . . .	143
Exa 28.9	gain and frequency . . . . .	144
Exa 28.10	frequency . . . . .	144
Exa 28.11	inductance and frequency . . . . .	144
Exa 28.13	frequency . . . . .	145
Exa 28.14	frequency . . . . .	145
Exa 28.15	frequency fs and fp . . . . .	146
Exa 29.1	FREQUENCY . . . . .	147
Exa 29.2	value of capacitors . . . . .	147
Exa 29.3	value of capacitors . . . . .	148
Exa 29.4	value of circuit components . . . . .	148

Exa 29.5	duty cycle . . . . .	149
Exa 29.6	R3 and C1 . . . . .	149
Exa 29.7	width . . . . .	150
Exa 29.8	value of pulse width . . . . .	150
Exa 29.9	CIRCUIT . . . . .	150
Exa 29.10	duty cycle . . . . .	151
Exa 29.11	frequency and graph . . . . .	152
Exa 29.12	design . . . . .	153
Exa 30.2	VOLTAGE . . . . .	154
Exa 30.3	VOLTAGE . . . . .	154
Exa 30.4	peak value of input voltage . . . . .	155
Exa 31.1	frequency . . . . .	156
Exa 31.2	period and frequency of oscillation and R . . . . .	156
Exa 32.1	CMRR . . . . .	158
Exa 32.2	common mode gain . . . . .	158
Exa 32.3	maximum frequency . . . . .	159
Exa 32.4	suitable opamps . . . . .	159
Exa 32.5	value of $v_{in}$ . . . . .	159
Exa 32.7	voltage . . . . .	160
Exa 32.8	output voltage . . . . .	160
Exa 32.9	gain input impedance cmrr and $f_{max}$ . . . . .	160
Exa 32.10	Acl CMRR and maximum operating frequency . . . . .	161
Exa 32.11	Acl CMRR and maximum operating frequency . . . . .	161
Exa 32.12	output voltage . . . . .	162
Exa 32.14	output voltage . . . . .	162
Exa 33.1	value of capacitance . . . . .	164
Exa 33.2	frequency . . . . .	164
Exa 33.3	cutoff frequency and max operating frequency . . . . .	165
Exa 33.4	frequency . . . . .	165
Exa 34.1	value of line regulation . . . . .	166
Exa 34.2	Change in output voltage . . . . .	166
Exa 34.3	value of load regulation . . . . .	167
Exa 34.4	voltage under full load . . . . .	167
Exa 34.5	magnitude of variation in output voltage . . . . .	167
Exa 34.6	load voltage voltage drop and current . . . . .	168
Exa 34.7	min and max value of input voltage . . . . .	168
Exa 34.8	min and max value of load current . . . . .	169
Exa 34.9	min and max value of zener current . . . . .	169

Exa 34.10	max value of $R_s$ and power . . . . .	170
Exa 34.11	regulated resistance . . . . .	170
Exa 34.12	min and max value of zener current . . . . .	171
Exa 34.13	zener regulator . . . . .	171
Exa 34.14	regulated voltage and circuit current . . . . .	172
Exa 34.15	voltage current . . . . .	172
Exa 34.16	max value of Resistance and power . . . . .	173
Exa 34.17	circuit and value of current . . . . .	174
Exa 34.18	$v_{out}$ $I_L$ $I_E$ $P_I$ . . . . .	175
Exa 34.19	min and max value of voltage . . . . .	175
Exa 34.20	regulated voltage . . . . .	176
Exa 34.21	regulated dc output voltage . . . . .	176

## Chapter 3

# SEMICONDUCTORS

Scilab code Exa 3.1 length of wire and current density

```
1 clc;
2 //Ex3.1
3 R=1000;
4 sigma=5.8*10**7;
5 d=0.001;
6 //l is length of the cu wire
7 l=R*sigma*pi*(d*d/4); //R=l/(sigma*pi*(d*d/4))
8 disp('km',l*10**-3,"l=");
9 E=10*10**-3;
10 J=sigma*E; //current density
11 disp('A/m^2',J*1,"J=");
```

---

Scilab code Exa 3.2 charge density of free electrons current density current flowi

```
1 clc;
2 //ex3.2
3 d=2*10**-3;
4 sigma=5.8*10**7;
```

```

5 mu=0.0032;
6 E=20*10**-3;
7 q=1.6*10**-19;
8 n=sigma/(q*mu); //sigma=q*n*mu
9 disp(' /m^3 ',n*1,"n=");
10 J=sigma*E; //current density
11 disp(' A/m^2 ',J*1,"J=");
12 A=%pi*d*d/4; //area of cross-section of wire
13 disp(' m^2 ',A*1,"A=");
14 I=J*A; //current flowing in the wire
15 disp(' A ',I*1,"I=");
16 V=mu*E; //electron drift velocity
17 disp(' m/s ',V*1,"V="); //answer printed in the book is
    wrong

```

---

Scilab code Exa 3.3 mobility and relaxation time of electrons

```

1 clc;
2 //ex3.3
3 p=1.54*10**-8;
4 n=5.8*10**28;
5 q=1.6*10**-19;
6 sigma=1/p; //p=1/sigma.. conductivity
7 disp(' S/m ',sigma*1,"sigma=");
8 mu=sigma/(q*n*10^-2); //mobility
9 disp(' m^2/vs ',mu*1,"mu=");
10 m=9.1*10**-31;
11 t=(m*mu)/q; //relaxation time
12 disp(' ps ',t*10^12,"t=");

```

---

Scilab code Exa 3.4 intrinsic conductivity

```

1 clc;

```



```

2 //ex 3.4
3 mun=0.38;
4 mup=0.18;
5 n=2.5*10**19;
6 a=0.13;
7 b=0.05;
8 n2=1.5*10**16;
9 q=1.6*10**-19;
10 sigma=q*n*(mun+mup); // intrinsic conductivity for
    germanium
11 disp('ohm-mu^-1',sigma*1,"sigma=");
12 sigma1=q*n2*(a+b); //intrinsic conductivity for
    silicon
13 disp('ohm-m^-1',sigma1*1,"sigma1");

```

---

#### Scilab code Exa 3.5 intrinsic conductivity

```

1 clc;
2 //ex3.5
3 n=1.41*10**16;
4 mun=0.145;
5 mup=0.05;
6 q=1.6*10**-19;
7 //sigma=q*n*(mun+mup);
8 e=q*n*mun; //contribution by electrons
9 h=q*n*mup; //contribution by holes
10 disp('ohm-m^-1',e*1,"e=");
11 disp('ohm-m^-1',h*1,"h=");

```

---

#### Scilab code Exa 3.6 concentration of free electrons and drift velocity

```

1 clc;
2 //ex3.6

```

```

3 q=1.60*10**-19;
4 l=0.2*10**-3;
5 a=0.04*10**-6;
6 v=1;
7 i=8*10**-3;
8 mun=0.13;
9 //concentration of free electrons
10 R=v/i;//resistance
11 disp('ohm',R*1,"R=");
12 rho=(R*a)/l;
13 disp('ohm-m',rho*1,"rho=");
14 sigma=1/rho;//conductivity
15 n=sigma/(q*mun);//concentration of free electrons
16 disp('/m^3',n*1,"n=")
17 //Drift velocity
18 j=i/a;
19 disp('amp/m^2',j*1,"j=");
20 v=j/(n*q);
21 disp('m/sec',v*1,"v=");

```

---

### Scilab code Exa 3.7 intrinsic carrier concentration

```

1 clc;
2 //ex3.7
3 rho=0.47;
4 q=1.6*10**-19;
5 mun=0.39;
6 mup=0.19;
7 sigma=1/rho;//conductivity of intrinsic
  semiconductor
8 disp('ohm-m^-1',sigma*1,"sigma=");
9 n=sigma/(q*(mun+mup));//intrinsic carrier
  concentration of germanium
10 disp('/m^3',n*1,"n=");

```

---

### Scilab code Exa 3.8 conductivity

```
1 clc;  
2 //e.g 3.8  
3 ND=10**21;  
4 NA=5*10**20;  
5 q=1.6*10**-19;  
6 mun=0.18;  
7 ND1=ND-NA; //number of free electrons  
8 disp( '/m^3 ', ND1*1, "ND1=" );  
9 SIGMA=ND1*q*mun; //conductivity of silicon  
10 disp( 'ohm-m^-1 ', SIGMA*1, "SIGMA=" );
```

---

### Scilab code Exa 3.9 donor concentration

```
1 clc;  
2 //ex3.9  
3 rho=100;  
4 q=1.6*10**-19;  
5 mun=0.36;  
6 sigma=1/rho;  
7 disp( '(ohm-m)^-1 ', sigma*1, "sigma=" );  
8 ND= sigma/(q*mun); //donar concentration  
9 disp( 'atoms/m^3 ', ND*1, "ND=" );
```

---

### Scilab code Exa 3.10 concentration of electrons and holes

```
1 clc;  
2 //e.g 3.10
```

```

3 ND=2*10**14;
4 NA=3*10**14;
5 ni=2.3*10**19;
6 n=(ni^2)/NA;
7 disp('electrons/cm^3',n*1,"n=");
8 p=(ni^2)/ND;
9 disp('holes/cm^3',p*1,"p=");

```

---

### Scilab code Exa 3.11 minority electron and hole density

```

1 clc;
2 //e.g 3.11
3 ND=5*10**8;
4 NA=6*10**16;
5 ni=1.5*10**10;
6 n=(ni^2)/NA;//number of electrons
7 p=(ni^2)/ND;//number of holes
8 disp(n*1,"n=");
9 disp(p*1,"p=");

```

---

### Scilab code Exa 3.12 length

```

1 clc;
2 //ex3.12
3 d=0.001;
4 q=1.6*10**-19;
5 ND=10**20;
6 R=1000;
7 mun=0.1;
8 n=ND;//number of free electrons
9 sigma=q*n*mun;//conductivity
10 disp('S/m',sigma*1,"sigma=");
11 a=(1/sigma)*(1/(%pi*(0.001^2)/4));

```

```
12 l=R/a;
13 disp('mm',l*10**3,"l=");
```

---

Scilab code Exa 3.13 concentration of holes and electrons

```
1 clc;
2 //ex3.13
3 sigma=100;
4 rho=0.1;
5 ni=1.5*10**10;
6 mun=1300;
7 mup=500;
8 ni1=2.5*10**13;
9 mun1=3800;
10 mup1=1800;
11 q=1.602*10**-19;
12 //concentration of p type germanium
13 p=sigma/(q*mup1);
14 disp('/cm^3',p*1,"p=");
15 n=(ni1^2)/p;
16 disp('/cm^3',n*1,"n=");
17 //concentration of n type silicon
18 n=rho/(mun*q);
19 disp('/cm^3',n*1,"n=");
20 p=(ni^2)/n;
21 disp('/cm^3',p*1,"p=");
```

---

Scilab code Exa 3.14 resistivity of germanium sample

```
1 clc;
2 mun=3800;
3 mup=1800;
4 ni=2.5*10**13;
```

```

5 Nge=4.41*10**22;
6 q=1.602*10**-19;
7 ND=Nge/10**8;
8 disp( '/cm^3 ',ND*1,"ND=");
9 p=(ni^2)/ND;
10 disp( '/cm^3 ',p*1,"p=");
11 n=ND;
12 sigma=q*n*mun;
13 disp( '(ohm-cm)^-1 ',sigma*1,"sigma=");
14 rho=1/sigma;
15 disp( 'ohm-cm ',rho*1,"rho=");

```

---

### Scilab code Exa 3.15 resistivity of intrinsic silicon

```

1 clc;
2 //ex3.15
3 Nsi=4.96*10**22;
4 ni=1.52*10**10;
5 q=1.6*10**-19;
6 mun=1350;
7 mup=480;
8 //resistivity of intrinsic silicon
9 sigma=q*ni*(mun+mup)
10 disp( '(ohm-cm)^-1 ',sigma*1,"sigma=");
11 rho=1/sigma;
12 disp( 'ohm-cm ',rho*1,"rho=");
13 //resistivity of doped silicon
14 ND=Nsi/(50*10^6);
15 disp( '/cm^3 ',ND*1,"ND=");
16 n=ND;
17 p=(ni**2)/n;
18 disp( '/cm**3 ',p*1,"p=");
19 sigma=q*n*mun;
20 disp( '(ohm-cm)^-1 ',sigma*1,"sigma=");
21 rho=1/sigma;

```

```
22 disp('ohm-cm',rho*1,"rho=");
```

---

### Scilab code Exa 3.16 conductivity of silicon

```
1 clc;
2 mup=0.048;
3 mun=0.135;
4 q=1.602*10**-19;
5 Nsi=5*10**28;
6 ni=1.5*10**16;
7 sigma=q*ni*(mun+mup);
8 disp('ohm-m^-1',sigma*1,"sigma=");
9 NA=Nsi/10**7;
10 P=NA;
11 n=ni^2/P;
12 sigma=q*P*mup;
13 disp('ohm-m^-1',sigma*1,"sigma=");
14 alpha=0.05;
15 T=34-20;
16 sigma20=0.44*10**-3;
17 sigma34=sigma20*(1+alpha*T);
18 disp('ohm-m^-1',sigma34*1,"sigma34=");
```

---

### Scilab code Exa 3.17 diffusion coefficients of holes and electrons

```
1 clc;
2 //e.g 3.17
3 mun=3600;
4 mup=1700;
5 k=1.38*10**23;
6 T=300;
7 DP=mup*(T/11600); //answer given in the book is wrong
8 disp('m^2/s',DP*1,"DP=");
```

```
9 Dn=mun*(T/11600); //answer given in the book is wrong
10 disp('m^2/s',Dn*1,"Dn=");
```

---

#### Scilab code Exa 3.18 electron mobility

```
1 clc;
2 //e.g 3.18
3 RH=160;
4 rho=0.16;
5 mun=(1/rho)*RH;
6 disp('cm^2/volt-sec',mun*1,"mu=");
```

---

#### Scilab code Exa 3.19 conduction electrons

```
1 clc;
2 //ex3.19
3 I=50;
4 B=1.2;
5 t=0.5*10**-3;
6 Vh=100;
7 q=1.6*10**-19;
8 n=(B*I)/(Vh*q*t);
9 disp('/m^3',n*1,"n=");
```

---

#### Scilab code Exa 3.20 number of electrons

```
1 clc;
2 rho=20*10**-2;
3 mu=100*10**-4;
4 q=1.6*10**-19;
```



```
5 n=1/(rho*q*mu);
6 disp( '/m^3 ',n*1,"n=");
```

---

### Scilab code Exa 3.21 mobility and density of charge carrier

```
1 clc;
2 Rh=3.66*10**-4;
3 rho=8.93*10**-3;
4 mu=Rh/rho;
5 disp( 'm^2/V-s ',mu*1,"mu=");
6 q=1.6*10^-19;
7 n=1/(q*Rh);
8 disp( '/m^3 ',n*1,"n=");
```

---

### Scilab code Exa 3.22 resistivity

```
1 clc;
2 //e.g 3.22
3 rho=9*10**-3;
4 mup=0.003;
5 sigma=1/rho;
6 disp( 'S/m',sigma*1,"sigma=");
7 RH= mup/sigma;
8 disp( 'm^3*C',RH*1,"RH=");
```

---

# Chapter 5

## PN JUNCTION DIODE

Scilab code Exa 5.1 Current

```
1 clc;
2 //e.g 5.1
3 I0=2*10**-7;
4 Vf=0.1;
5 I=I0*(exp (40*Vf)-1);
6 disp('uA', I*10**6, " I=");
```

---

Scilab code Exa 5.2 find current

```
1 clc;
2 //e.g 5.2
3 I0=1*10**-3;
4 Vf=0.22;
5 T=298;
6 n=1
7 VT=T/11600
8 disp('mV', VT*10**3, "VT=");
9 I=I0*(exp (Vf/(n*VT))-1);
10 disp('A', I*1, " I=");
```

---

**Scilab code Exa 5.3** value of n

```
1 clc ;
2 I1=0.5*10**-3;
3 V1=340*10**-3;
4 I2=15*10**-3;
5 V2=440*10**-3;
6 kTbyq=25*10**-3;
7 a=V1/kTbyq;
8 b=V2/kTbyq;
9 //log(I1/I2)==log(exp((b-a)/n));
10 n=(a-b)/(log(I1/I2));
11 disp(n);
```

---

**Scilab code Exa 5.4** saturation current

```
1 clc ;
2 I300=10*10**-6;
3 T1=300;
4 T2=400;
5 I400=I300*(2^((T2-T1)/10));
6 disp('mA', I400*10**3, " I400=");
```

---

**Scilab code Exa 5.5** value of VF for the device

```
1 clc ;
2 rB=2;
3 IF=12*10**-3;
4 VF=0.7+IF*rB;
```

```
5 disp('V',VF*1,"VF=");
```

---

#### Scilab code Exa 5.8 dc current and PDmax

```
1 clc;  
2 PD=0.5;  
3 VF=1;  
4 VBR=150;  
5 IF=(PD/VF);  
6 disp('A',IF*1,"IF=");  
7 IR=(PD/VBR);  
8 disp('mA',IR*10**3,"IR=");
```

---

#### Scilab code Exa 5.9 voltage drop and current

```
1 clc;  
2 R=330;  
3 VS=5;  
4 VD=VS;  
5 disp('V',VD*1,"VD=VS=");  
6 VR=0;  
7 disp(VR,"VR=");  
8 I=0;  
9 disp(I,"I=");
```

---

#### Scilab code Exa 5.10 VD VR I

```
1 clc;  
2 VS=12;  
3 R=470;
```

```
4 VD=0;
5 disp(VD);
6 VR=VS;
7 disp('V',VR*1,"VR=");
8 I=(VS/R);
9 disp('mA',I*10**3,"I=");
```

---

#### Scilab code Exa 5.11 current

```
1 clc;
2 VS=6;
3 R1=330;
4 R2=470;
5 VD=0.7;
6 RT=R1+R2;
7 I=(VS-0.7)/RT;
8 disp('mA',I*10**3,"I=");
```

---

#### Scilab code Exa 5.12 voltage across resistor and current

```
1 clc;
2 VS=5;
3 R=510;
4 VF=0.7;
5 VR=VS-0.7;
6 disp('V',VR*1,"VR=");
7 I=VR/R;
8 disp('mA',I*10**3,"I=");
```

---

#### Scilab code Exa 5.13 total current

```
1 clc;
2 VS=6;
3 VD1=0.7;
4 VD2=0.7;
5 VR=1.5*10**3;
6 I=(VS-VD1-VD2)/VR;
7 disp('mA', I*10**3, ' I=');
```

---

#### Scilab code Exa 5.14 total current

```
1 clc;
2 VS=12;
3 R1=1.5*10**3;
4 R2=1.8*10**3;
5 VD1=0.7;
6 VD2=0.7;
7 I=(VS-VD1-VD2)/(R1+R2);
8 disp('mA', I*10**3, ' I=');
```

---

#### Scilab code Exa 5.15 output voltage

```
1 clc;
2 V1=0;
3 V2=0;
4 V0=0;
5 disp('V', V0*1, 'VO=');
6 V1=0;
7 V2=5;
8 V0=V2-0.7;
9 disp('V', V0*1, 'VO=');
10 V1=5;
11 V2=0;
12 V0=V1-0.7;
```

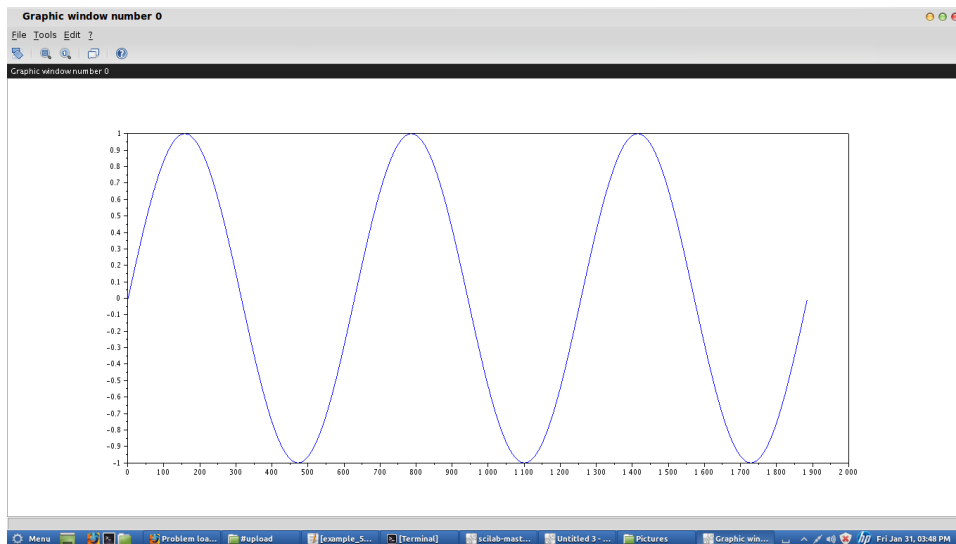


Figure 5.1: waveform of voltage

```

13 disp( 'V' ,V0*1 , "VO=" );
14 V1=5;
15 V2=5;
16 V0=V2-0.7;
17 disp( 'V' ,V0*1 , "VO=" );

```

---

#### Scilab code Exa 5.16 waveform of voltage

```

1 clc;
2 R=20*10**3;
3 I=(R-0.7)/R;
4 disp( 'mA' ,I*1 , "I=" );
5 rj=50;
6 rB=1;
7 re=rB+rj;
8 R1=(R*re)/(re+R);

```

```
9 disp(R1);
10 V=10*(re/(re+1000));
11 disp('mV',V*1,"V=");
12 i=0:0.01:6*%pi;
13 plot(sin(i));
```

---



## Chapter 7

# SPECIAL PURPOSE DIODES AND OPTO ELECTRONIC DEVICES

Scilab code Exa 7.1 value of  $I_{zm}$

```
1 clc ;  
2 //ex7.01  
3 pzm=500*10**-3 ;  
4 vz=6.8 ;  
5 Izm=pzm/vz ;  
6 disp ( 'mA' , Izm*10**3 , " Izm=" ) ;
```

---

Scilab code Exa 7.2 maximum power dissipation

```
1 clc ;  
2 //pg no. 117  
3 pzm=500*10**-3 ;  
4 d=3.33*10**-3 ;  
5 a=75 ;
```

```
6 b=50;
7 Td=d*(a-b);
8 disp('mW',Td*10**3,"Td=");
9 pz=pzm-Td ;
10 disp('mW',pz*10**3,"pz=");
```

---

#### Scilab code Exa 7.3 resistance of device

```
1 clc;
2 //pg n0 120
3 IZ=10*10**-3;
4 vz=0.05;
5 rz=vz/IZ;
6 disp('ohm',rz*1,"rz=");
```

---

#### Scilab code Exa 7.4 terminal voltage

```
1 clc;
2 Vz=4.7;
3 rz=15;
4 Iz=20*10**-3;
5 VZ1= Vz+(rz*Iz);
6 disp('V',VZ1*1,"VZ1=");
```

---

#### Scilab code Exa 7.5 tuning range

```
1 clc;
2 //e.g7.5
3 C1=5*10**-12; //min
4 C2=5*10**-12; //min
```

```

5 L=10*10**-3;
6 CT=(C1*C2)/(C1+C2); //CTmax
7 disp('F',CT*1,"CT=");
8 fo=1/(2*%pi*sqrt(L*CT));
9 disp('MHZ',fo*10**-6,"fo=");
10 C1=50*10**-12; //max
11 C2=50*10**-12; //max
12 CT=(C1*C2)/(C1+C2); //CTmin
13 disp('F',CT*1,"CT=");
14 fo=1/(2*%pi*sqrt(L*CT));
15 disp('kHz',fo*10**-3,"fo=");

```

---

Scilab code Exa 7.6 frequency of 5th harmonic

```

1 clc;
2 //e.g 7.6
3 T=0.04*10**-6;
4 f=1/T;
5 disp('MHz',f*10**-6,"f=");
6 disp('MHz',f*5*10**-6,"f="); //frequency of 5th
   harmonic

```

---

Scilab code Exa 7.7 resistor

```

1 clc;
2 //e.g 7.7
3 Vs=8;
4 VDmin=1.8;
5 VDmax=2;
6 Ifmax=16*10**-3;
7 Rs=(Vs-VDmin)/Ifmax;
8 disp('ohm',Rs*1,"Rs=");
9 Rsmax=(Vs-VDmax)/Ifmax;

```

```
10 disp('ohm',Rsmax*1,"Rsmax=");
```

---

Scilab code Exa 7.8 minimum and maximum value of current

```
1 clc;
2 //e.g 7.8
3 VDmin=1.5;
4 VDmax=2.3;
5 Vs=10;
6 R1=470;
7 Imax=(Vs-VDmin)/R1;
8 disp('mA',Imax*10**3,"Imax=");
9 Imin=(Vs-VDmax)/R1;
10 disp('mA',Imin*10**3,"Imin=")
```

---

Scilab code Exa 7.9 Imin and Imax

```
1 clc;
2
3 //e.g 7.9
4 VDmin=1.8;
5 VDmax=3;
6 Vs1=24;
7 Rs1=820;
8 Vs2=5;
9 Rs2=120;
10 Imin=(Vs2-VDmax)/Rs2;
11 disp('mA',Imin*10**3,"Imin=");
12 Imax=(Vs1-VDmin)/Rs1;
13 disp('mA',Imax*10**3,"Imax=");
14 Imin=(Vs2-VDmax)/Rs2;
15 disp('mA',Imin*10**3,"Imin=");
16 Imax=(Vs2-VDmin)/Rs2;
```

```
17 disp('mA', Imax*10**3, " Imax=");
```

---

Scilab code Exa 7.10 resistance and current

```
1 clc;
2 r=1*10**3;
3 I=10*10**-3;
4 V=30;
5 //I=30/(R+r)
6 R=(V/I)-r; //when dark
7 disp('Kohm', R*10**-3, "R=");
8 R=100*10**3; //when illuminated
9 Id=(V/(r+R));
10 disp('mA', Id*10**3, " Id=");
```

---

# Chapter 8

## BIPOLAR JUNCTION TRANSISTORS

Scilab code Exa 8.1 base current

```
1 clc;  
2 //e.g 8.1  
3  $I_e = 10 \times 10^{-3}$ ;  
4  $I_c = 9.8 \times 10^{-3}$ ;  
5 //  $I_e = I_b + I_c$   
6  $I_b = I_e - I_c$ ;  
7 disp( 'mA' ,  $I_b \times 10^3$  , "  $I_b =$ " );
```

---

Scilab code Exa 8.2 current gain

```
1 clc;  
2 //e.g 8.2  
3  $I_e = 6.28 \times 10^{-3}$ ;  
4  $I_c = 6.20 \times 10^{-3}$ ;  
5  $a = I_c / I_e$ ;  
6 disp(a);
```

---

### Scilab code Exa 8.3 base current

```
1 clc;
2 //e.g8.3
3 a=0.967;
4 Ie=10*10**-3;
5 Ic=Ie*a; //a=Ic/Ie
6 disp('mA',Ic*10**3,"Ic=");
7 Ib=Ie-Ic;
8 disp('mA',Ib*10**3,"Ib=");
```

---

### Scilab code Exa 8.4 IC and IB

```
1 clc;
2 //e.g 8.4
3 Ie=10*10**-3;
4 alpha=0.987;
5 Ic=Ie*alpha; //alpha=Ic/Ie
6 disp('mA',Ic*10**3,"Ic=");
7 Ib=Ie-Ic;
8 disp('mA',Ib*10**3,"Ib=");
```

---

### Scilab code Exa 8.5 alpha and beta

```
1 clc;
2 //e.g 8.5
3 alpha=0.975;
4 beta=200;
5 beta=(alpha/(1-alpha));
```

```
6 disp(beta);
7 alpha=(beta/(1+beta));
8 disp(alpha);
```

---

#### Scilab code Exa 8.6 emitter current

```
1 clc;
2 //e.g 8.6
3 BETA=100;
4 IC=40*10**-3;
5 IB=IC/BETA;
6 IE=IC+IB;
7 disp('mA', IE*10**3, 'IE=');
```

---

#### Scilab code Exa 8.7 current

```
1 clc;
2 //e.g 8.7
3 beta=150;
4 Ie=10*10**-3;
5 alpha=beta/(1+beta)
6 Ic=alpha*Ie; //as alpha=(Ic/Ie)
7 disp('mA', Ic*10**3, 'Ic=');
8 Ib=Ie-Ic; //as Ie=Ib+Ic
9 disp('mA', Ib*10**3, 'Ib=');
```

---

#### Scilab code Exa 8.8 IB and IE

```
1 clc;
2 //e.g 8.8
```



```
3 beta=170;
4 Ic=80*10**-3;
5 Ib=Ic/beta; //beta=(Ic/Ib)
6 disp('mA',Ib*10**3,"Ib=");
7 Ie=Ic+Ib;
8 disp('mA',Ie*10**3,"Ie=");
```

---

#### Scilab code Exa 8.9 IC and IE

```
1 clc;
2 //e.g 8.9
3 Ib=125*10**-6;
4 beta=200;
5 Ic=beta*Ib;
6 disp('mA',Ic*10**3,"Ic=");
7 Ie=Ib+Ic;
8 disp('mA',Ie*10**3,"Ie=");
```

---

#### Scilab code Exa 8.10 IC and IB

```
1 clc;
2 //e.g 8.10
3 Ie=12*10**-3;
4 beta=140;
5 Ib=Ie/(1+beta);
6 disp('mA',Ib*10**3,"Ib=");
7 Ic=Ie-Ib;
8 disp('mA',Ic*10**3,"Ic=");
```

---

#### Scilab code Exa 8.11 beta emitter current and new value of beta

```

1  clc;
2  IB=105*10**-6;
3  IC=2.05*10**-3;
4  BETA=IC/IB;
5  disp(BETA);
6  ALPHA=BETA/(1+BETA);
7  disp(ALPHA);
8  IE=IC+IB;
9  disp('mA', IE*10**3, "IE=");
10 DELTA_IB=27*10**-6;
11 DELTA_IC=0.65*10**-3;
12 IBn=IB+DELTA_IB;
13 ICn=IC+DELTA_IC;
14 BETAn=ICn/IBn;
15 disp(BETAn);

```

---

#### Scilab code Exa 8.12 collector and emitter current

```

1  clc;
2  //e.g 8.12
3  alpha=0.98;
4  Ico=5*10**-6;
5  Ib=100*10**-6;
6  Ic=((alpha*Ib)/(1-alpha))+ (Ico/(1-alpha));
7  disp('mA', Ic*10**3, "Ic=");
8  Ie=Ib+Ic;
9  disp('mA', Ie*10**3, "Ie=");

```

---

#### Scilab code Exa 8.13 collector current

```

1  clc;
2  //e.g 8.13
3  Icbo=10*10**-6;

```

```
4 beta=50;
5 //Value of collector current when Ib=0.25*10**-3;
6 Ib=0.25*10**-3;
7 Ic=(beta*Ib)+(1+beta)*Icbo;
8 disp('mA',Ic*10**3,"Ic=");
9 //Value of new collector current if temperature
   rises to 50 degree
10 t1=27;
11 t2=50;
12 Icbo50=Icbo*2^((t2-t1)/10);
13 disp('microA',Icbo50*10**6,"Icbo50=");
14 //collector current at 50 degree
15 Ic=beta*Ib+(1+beta)*Icbo50;
16 disp('mA',Ic*10**3,"Ic=");
```

---

# Chapter 9

## BJT CHARACTERISTICS

Scilab code Exa 9.1 PDmax

```
1 clc ;  
2 //e.g 9.1  
3 Pdmax=500*10**-3;  
4 DF=2.28*10**-3;  
5 T=70;  
6 Pdmax70=Pdmax-DF*(T-25);  
7 disp('w',Pdmax70*1,"Pdmax70=");
```

---

# Chapter 10

## BJT LOW AND HIGH FREQUENCY MODELS

Scilab code Exa 10.1 hybrid pi parameters

```
1  clc;
2  //e.g 10.1
3  Ic=10;
4  Vce=10;
5  hie=500;
6  hoe=10**-5;
7  hfe=100;
8  hre=10**-4;
9  gm=Ic/25;
10 disp('ohm',gm*1,"gm=");
11 rbe=hfe/gm;
12 disp('ohm',rbe*1,"rbe=");
13 rbb=hie-rbe;
14 disp(rbb);
15 gbc=hre/rbe;
16 disp('*10^-7',gbc*10**7,"gbc=");
17 rce=-1/((hoe-(1+hfe)*gbc));
18 disp('kohm',rce*10**-3,"rce=");
```

---

# Chapter 11

## BJT LOW AND HIGH FREQUENCY MODELS

Scilab code Exa 11.1 drain current

```
1  clc
2  //e.g 11.1
3  Idss=15*10**-3;
4  Vgso=-5;
5  //Id=Idss*(1-(Vgs/Vgso))^2
6  Vgs=0;
7  Id=Idss*(1-(Vgs/Vgso))^2;
8  disp('mA', Id*10**3, " Id=");
9  Vgs1=-1;
10 Id=Idss*(1-(Vgs1/Vgso))^2;
11 disp('mA', Id*10**3, " Id=");
12 Vgs2=-4;
13 Id=Idss*(1-(Vgs2/Vgso))^2;
14 disp('mA', Id*10**3, " Id=");
```

---

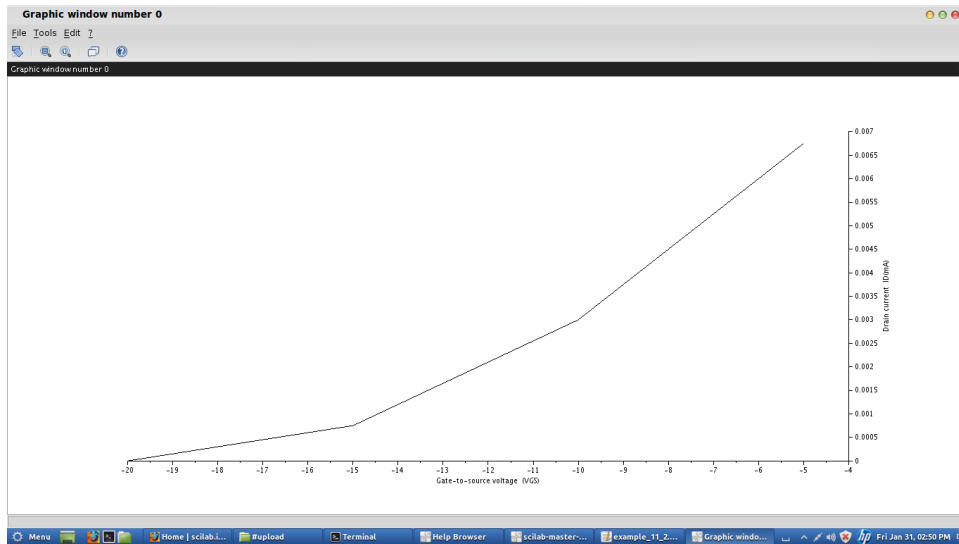


Figure 11.1: transconductance curve

#### Scilab code Exa 11.2 transconductance curve

```

1  clc;
2  Vgs=-5:-5:-20; // Id=Idss*(1-(Vgs/Vgso))^2
3  Vgso=-20;
4  Idss=12*10**-3;
5  Id=Idss*(1-(Vgs/Vgso))^2;
6  disp('mA', Id*10**3, " Id=");
7  y=0:1:12;
8  x=0:-5:-20;
9  a=gca() //get the current axes
10 a.box="off";
11 a.y_location="right";
12 plot2d(Vgs, Id);
13 xlabel("Gate-to-source voltage (VGS)");
14 ylabel("Drain current ID (mA)");

```

---

#### Scilab code Exa 11.4 DRAIN CURRENT AND TRANSCONDUCTANCE

```

1  clc;
2  //e.g 11.4
3  Idss=20*10**-3;
4  vp=-8;
5  gmo=5000*10**-6;
6  vgs=-4;
7  //Id=Idss*(1-(Vgs/Vgso))^2
8  Id=Idss*(1-(vgs/vp))^2;
9  disp('mA', Id*10**3, "Id=");
10 gm=gmo*(1-(vgs/vp));
11 disp('microsec', gm*10**6, "gm=");

```

---

#### Scilab code Exa 11.5 value og ID

```

1  clc;
2  //e.g 11.5
3  Idon=10*10**-3;
4  vgs=-12;
5  vgsth=-3;
6  //Id=K*(vgs-vgsth)^2
7  //Idon=K*(vgs-vgsth)^2
8  k=Idon/((vgs-vgsth)^2);
9  disp('mA', k*10**3, "k=");
10 vgs1=-6;
11 Idon=k*(vgs1-vgsth)^2;
12 disp('mA', Idon*10**3, "Idon=");

```

---



# Chapter 12

## THYRISTORS

Scilab code Exa 12.1 destroy the device or not

```
1 clc;  
2 //e.g 12.1  
3 I=40;  
4 t=15*10**-3;  
5 SCR=(I^2)*t;  
6 disp('A^2s',SCR*1,"SCR=");
```

---

Scilab code Exa 12.2 max allowable duration

```
1 clc;  
2 //e.g 12.2  
3 a=75;  
4 Is=100;  
5 tmax=a/Is**2;  
6 disp('ms',tmax*10**3,"tmax=");
```

---

### Scilab code Exa 12.3 voltage

```
1 clc ;
2 //e.g 12.3
3 VD=0.7;
4 n=0.75;
5 Vbb=12;
6 Vp=n*Vbb+VD;
7 disp( 'V',Vp*1, "Vp=" );
```

---

### Scilab code Exa 12.4 intrinsic stand off ratio and peak point voltage

```
1
2 clc ;
3 //e.g 12.4
4 rb1=4*10**3;
5 rb2=2.5*10**3;
6 Vbb=15;
7 Vd=0.7;
8 n=rb1/(rb1+rb2);
9 disp(n, "n="); //intrinsic standoff ratio
10 Vp=n*Vbb+Vd;
11 disp( 'V',Vp*1, "Vp=" ); //peak point voltage
```

---

### Scilab code Exa 12.5 rB1 and rB2

```
1 clc ;
2 //e.g 12.5
3 n=0.60;
4 rbb=7*10**3;
5 rb1=rbb*n;
6 disp( 'kohm',rb1*10**-3, "rb1=" );
7 rb2=rbb-rb1;
```

```
8 disp('kohm',rb2*10**-3,'rb2=');
```

---

# Chapter 13

## PASSIVE CIRCUITS DEVICES

Scilab code Exa 13.4 tolerance

```
1  clc;
2  R1min=2.7;
3  R2min=5.1;
4  Rmin=R1min+R2min;
5  R1max=3.3;
6  R2max=6.9;
7  Rmax=R1max+R2max;
8  a=9-Rmin;
9  b=Rmax-9;
10 tolerance=b/9;
11 Reqmin=(R1min*R2min)/(R1min+R2min);
12 disp('ohm',Reqmin*1,"Reqmin=");
13 Reqmax=(R1max*R2max)/(R1max+R2max);
14 disp('ohm',Reqmax*1,"Reqmax=");
15 R1N=3;
16 R2N=6;
17 Req=(R1N*R2N)/(R1N+R2N);
18 disp('ohm',Req*1,"Req=");
19 minval=Reqmin;
```

```
20 maxval=Reqmax;
21 maxchng=0.235;
22 t=(maxchng/2)*100;
23 disp('%',t*1,'t=');
```

---

### Scilab code Exa 13.5 coil inductance

```
1 clc;
2 //e.g 13.5
3 N=150;
4 mur=3540;
5 mu0=4*%pi*10**-7;
6 l=0.05;
7 A=5*10**-4;
8 L=(mur*mu0*A*N*N)/l;
9 disp('H',L*1,'L=');
```

---

### Scilab code Exa 13.6 coefficient of Coupling

```
1 clc;
2 //e.g 13.6
3 L1=40*10**-6;
4 L2=80*10**-6;
5 M=11.3*10**-6;
6 k=M/sqrt(L1*L2);
7 disp(k);
```

---

### Scilab code Exa 13.7 Q factor of coil

```
1 clc;
```

```
2 //e.g 13.7
3 Q=90;
4 L=15*10**-6;
5 f=10*10**6;
6 R0=(2*%pi*f*L)/Q;
7 disp('ohm',R0*1,"R0=");
```

---

#### Scilab code Exa 13.8 capacitance

```
1 clc;
2 //e.g 13.8
3 A=0.04;
4 d=0.02;
5 e0=8.85*10**-12;
6 er=5.0;
7 C=(e0*er*A)/d;
8 disp('pF',C*10**12,"C="); //answer printed in the
    book is wrong.
```

---

#### Scilab code Exa 13.9 thickness of dielectric

```
1 clc;
2 //e.g 13.9
3 A=0.2;
4 C=0.428*10**-6;
5 e0=8.85*10**-12;
6 er=1200;
7 d=(e0*er*A)/C; //ans printed in the book is wrong
8 disp('mm',d*10**3,"d=");
```

---

## Chapter 16

# PN JUNCTION DIODE APPLICATIONS RECTIFIERS AND FILTERS

Scilab code Exa 16.1 dc output voltage and PIV

```
1  clc;
2  //e.g 16.1
3  V1=230;
4  //a=(N2/N1)
5  b=(1/10);
6  V2=V1*b;
7  disp('V',V2*1,"V2=");
8  Vm=sqrt(2)*V2;
9  disp('V',Vm*1,"Vm=");
10 Vdc=0.318*Vm;
11 disp('V',Vdc*1,"Vdc=");
12 PIV=Vm;
13 disp('V',PIV*1,"PIV=");
```

---

### Scilab code Exa 16.2 dc load current

```
1  clc;
2  //e.g 16.2
3  RL=20*10**3;
4  V2=24;
5  Vm=sqrt(2)*V2;
6  disp('V',Vm*1,"Vm=");
7  Im=Vm/RL;
8  disp('mA',Im*10**3,"Im=");
9  Idc= 0.318*Im;
10 disp('mA',Idc*10**3,"Idc=");
```

---

### Scilab code Exa 16.3 maximum and average power

```
1  clc;
2  //e.g 16.3
3  V1=230;
4  //a=(N2/N1)
5  b=(1/2);
6  RL=200;
7  V2=V1*b;
8  disp('V',V2*1,"V2=");
9  Vm=sqrt(2)*V2;
10 disp('V',Vm*1,"Vm=");
11 Im=Vm/RL;
12 disp('A',Im*1,"Im=");
13 Pm=(Im**2)*RL;
14 disp('W',Pm*1,"Pm=");
15 Vdc=0.318*Vm;
16 disp('V',Vdc*1,"Vdc=");
17 Idc=(Vdc/RL);
18 disp('A',Idc*1,"Idc=");
19 Pdc=(Idc**2)*RL;
20 disp('W',Pdc*1,"Pdc=");
```



---

Scilab code Exa 16.4 maximum ac voltage

```
1 clc;
2 //e.g 16.4
3 Vdc=30;
4 RL=600;
5 Rf=25;
6 Idc=(Vdc/RL);
7 disp('A', Idc*1, " Idc=");
8 Im=%pi*Idc;
9 disp('A', Im*1, " Im=");
10 Vin=Im*(Rf+RL);
11 disp('V', Vin*1, " Vin=");
```

---

Scilab code Exa 16.5 dc output voltage

```
1
2 clc;
3 V2=30;
4 RL=5.1*10**3;
5 VS=V2/2;
6 Vm=sqrt(2)*VS;
7 Vdc=0.636*Vm;
8 disp('V', Vdc*1, " Vdc=");
9 Vdc=Vdc/RL;
10 disp('mA', Vdc*10**3, " Vdc=");
```

---

Scilab code Exa 16.6 dc output voltage and PIV and output frequency

```

1  clc;
2  V1=230;
3  fin=50;
4  //let a=N1/N2
5  a=1/4;
6  V2=V1*a;
7  Vm=sqrt(2)*V2;
8  Vdc=0.636*Vm;
9  disp('V',Vdc*1,"Vdc=");
10 PIV=Vm;
11 disp('V',PIV*1,"PIV=");
12 fout=2*fin;
13 disp('HZ',fout*1,"fout=");

```

---

Scilab code Exa 16.7 dc output voltage PIV and rectification efficiency

```

1  clc;
2  V1=230;
3  //LET a=N2/N1
4  a=1/5;
5  RL=100;
6  V2=V1*a;
7  Vs=V2/2;
8  Vm=sqrt(2)*Vs;
9  Vdc=2*Vm/%pi;
10 disp('V',Vdc*1,"Vdc=");
11 PIV=2*Vm;
12 disp('V',PIV*1,"PIV=");
13 n=0.812//rectifier efficiency of full wave rectifier

```

---

Scilab code Exa 16.8 load resistor dc load voltage and PIV

```

1  clc;

```

```

2 Vs=200;
3 Imax=700*10**-3;
4 Iavg=250*10**-3;
5 Imax=0.8*Imax;
6 disp('mA', Imax*10**3, "Imax=");
7 Vm=sqrt(2)*Vs;
8 RL=Vm/Imax;
9 disp('ohm', RL*1, "RL=");
10 Vdc=2*Vm/%pi;
11 disp('V', Vdc*1, "Vdc=");
12 Idc=Vdc/RL;
13 disp('A', Idc*1, "Idc=");
14 PIV=2*Vm;
15 disp(PIV);

```

---

#### Scilab code Exa 16.9 inductance

```

1 clc;
2 f=50;
3 y=0.05;
4 RL=100;
5 L=RL/(y*3*sqrt(2)*2*%pi*f);
6 disp('H', L*1, "L=");
7 f=400;
8 y=0.05;
9 L=RL/(y*3*sqrt(2)*2*%pi*f);
10 disp('H', L*1, "L=");

```

---

#### Scilab code Exa 16.10 capacitance

```

1 clc;
2 Vdc=30;
3 RL=1*10**3;

```

```
4 y=0.01;
5 C=2890/(y*RL);
6 disp('microF',C*1,"C=");
```

---

#### Scilab code Exa 16.11 size of capacitor

```
1 clc;
2 Vdc=12;
3 Idc=100*10**-3;
4 y=0.01;
5 L=1;
6 C=1.195/(L*y);
7 disp('microF',C*1,"C=");
```

---

#### Scilab code Exa 16.12 ripple factor

```
1 clc;
2 Idc=0.2;
3 Vdc=30;
4 C1=100;
5 C2=100;
6 L=5;
7 f=50;
8 RL=Vdc/Idc;
9 y=5700/(L*C1*C2*RL);
10 disp('%',y*100,"y=");
```

---

#### Scilab code Exa 16.13 Vdc peak and average current and average power delivered

```
1 clc;
```

```
2 Vs=150;
3 Idc=2;
4 Vdc=2.34*Vs;
5 disp('V',Vdc*1,"Vdc=");
6 I=Idc/0.955;
7 disp('A',I*1,"I=");
8 Iavg=2/3;
9 disp('A',Iavg*1,"Iavg=");
10 Pdc=Vdc*Idc;
11 disp('W',Pdc*1,"Pdc=");
```

---

# Chapter 17

## CONTROLLED RECTIFIERS

Scilab code Exa 17.1 angular firing required

```
1  clc;
2  //e.g 17.1
3  RL=100;
4  Vm=300;
5  //load power P= Vdc*Idc
6  a=(Vm/(2*%pi))^2*(1/RL);
7  disp(a);
8  p=25;
9  //1+cosb=sqrt(25/a)
10 b=a*1+cos(sqrt(p/a));
11 cosalpha=(sqrt(p/a))-1;
12 disp(cosalpha);
13 p=80;
14 cosalpha=(sqrt(p/a))-1;
15 disp(cosalpha," cosalpha=");
16 //or;
17 alpha=acosd(cosalpha);
18 disp(' degree ',alpha," alpha=");
```

---

### Scilab code Exa 17.2 power

```
1  clc;
2  //e.g 17.2
3  vm=200;
4  Rl=1*10**3;
5  //ALPHA=0degree
6  Vdc=vm*0.318;
7  Idc=Vdc/Rl;
8  P=Vdc*Idc;
9  disp('mW',P*10**3,'P=');"OR";disp('W',P*1,'P=');
10 //alpha=45 degree
11 Vdc=vm*0.27;
12 Idc=Vdc/Rl;
13 P=Vdc*Idc;
14 disp('mW',P*10**3,'P=');"OR";disp('W',P*1,'P=');
15 //alpha=90 degree
16 Vdc=vm*0.159;
17 Idc=Vdc/Rl;
18 P=Vdc*Idc;
19 disp('mW',P*10**3,'P=');"OR";disp('W',P*1,'P=');
20 //alpha=135 degree
21 Vdc=vm*0.04660;
22 Idc=Vdc/Rl;
23 P=Vdc*Idc;
24 disp('mW',P*10**3,'P=');"OR";
```

---

### Scilab code Exa 17.3 voltage

```
1  clc;
2  //e.g 17.3
3  Vrms=220;
4  a=60;
5  Vm=sqrt(2)*Vrms;
6  disp('V',Vm*1,'Vm=');
```

```
7 Vdc=(Vm/(2*%pi))*(1+cosd(60));
8 disp('V',Vdc*1,"Vdc=");
```

---

#### Scilab code Exa 17.4 resistance

```
1 clc;
2 //e.g 17.4
3 Vrms=100;
4 a=45;
5 Idc=0.5;
6 Vm=sqrt(2)*Vrms;
7 disp('V',Vm*1,"Vm=");
8 //Idc=(Vm/(2*%pi*RL))*(1+cosd(a));
9 RL=(Vm/(2*%pi*Idc))*(1+cosd(a));
10 disp('ohm',RL*1,"RL=");
```

---

#### Scilab code Exa 17.5 chopper duty cycle and chopping frequency

```
1 clc;
2 //e.g 17.5
3 Ton=30*10**-6;
4 Toff=10*10**-6;
5 //consider duty cycle=a
6 a=Ton/(Ton+Toff);
7 disp(a);
8 f=(1/(Ton+Toff))
9 disp('kHz',f*10**-3,"f=");
```

---

#### Scilab code Exa 17.6 dc output voltage



```
1 clc;
2 //e.g 17.6
3 Ton=30*10**-3;
4 Toff=10*10**-3;
5 Vdc=200;
6 a=Ton/(Ton+Toff);
7 disp(a);
8 Vl=Vdc*a;
9 disp('V',Vl*1,"Vl=");
```

---

# Chapter 18

## BJT BIASING AND STABILISATION

Scilab code Exa 18.1 sturation current and cutoff voltage

```
1
2 clc;
3 //e.g 18.1
4 Vbb=10;
5 Rb=47*10**3;
6 Vcc=20;
7 Rc=10*10**3;
8 B=100;
9 Ic=Vcc/Rc;//saturation current
10 disp('mA',Ic*10**3,"Ic=");
11 Vce=Vcc;//cut-off voltage
12 disp('V',Vce*1,"Vce=");
13 i=2:-0.1:0;
14 plot2d(i);
15 a=gca() //get the current axes
16 a.box="off";
17 xlabel("VCE");
```

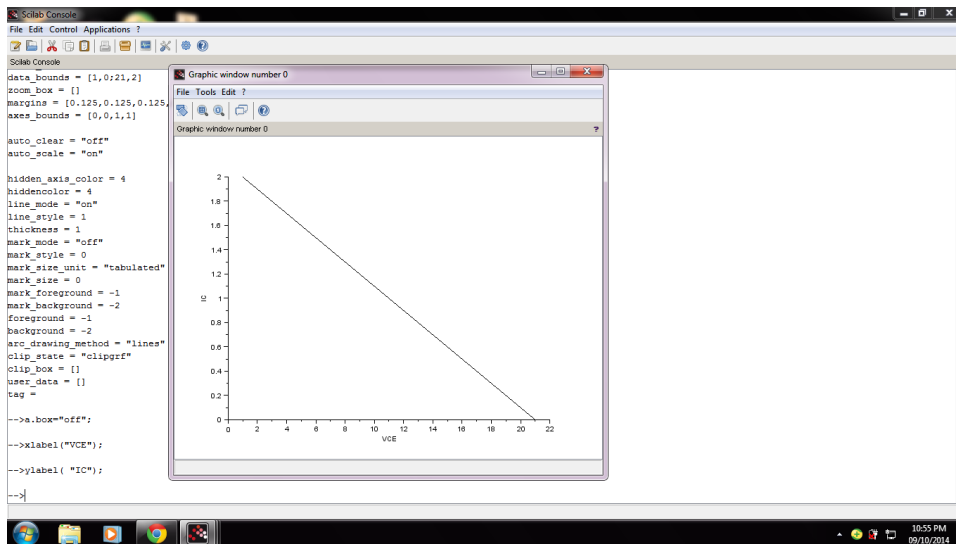


Figure 18.1: sturation current and cutoff voltage

18 ylabel( "IC");

---

Scilab code Exa 18.2 upper and lower ends of load line

```

1
2 clc;
3 //e.g 18.2
4 Vbb=10;
5 Rb=50*10**3;
6 Vcc=20;
7 Rc=300;
8 beta=200;
9 Ic=Vcc/Rc; //saturation current

```

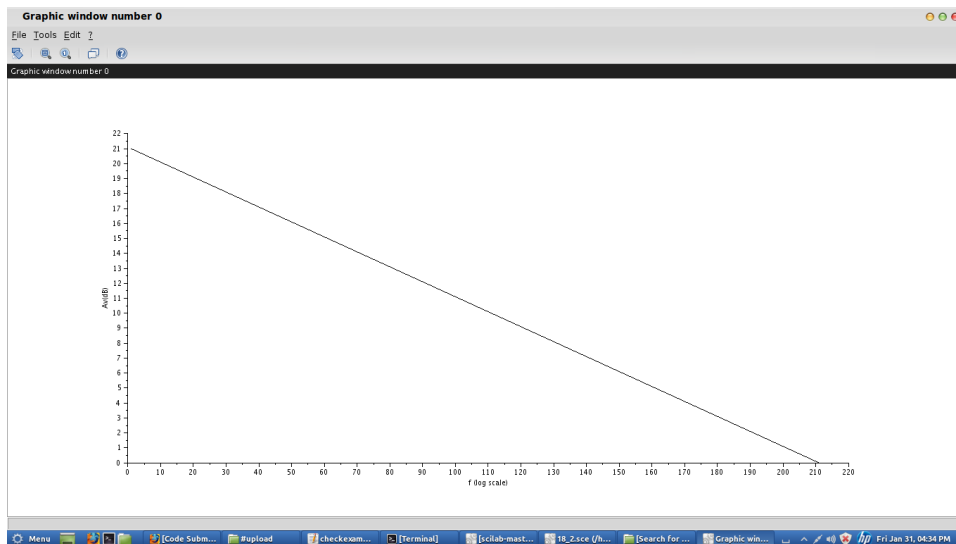


Figure 18.2: upper and lower ends of load line

```

10 disp('mA', Ic*10**3, " Ic=");
11 Vce=Vcc; //cut-off voltage
12 disp('V', Vce*1, " Vce=");
13 Ib=(Vbb-0.7)/Rb;
14 disp('10-3A', Ib*10**3, " Ib=");
15 Ic=beta*Ib;
16 disp('10-3A', Ic*10**3, " Ic=");
17 Vce=Vcc-Ic*Rc;
18 disp('V', Vce*1, " Vce=");
19 i=21:-0.1:0;
20 plot2d(i);
21 a=gca() //get the current axes
22 a.box="off";
23 xlabel("VCE");
24 ylabel("IC");

```

---

Scilab code Exa 18.3 base and collector current and VCE

```

1
2 clc;
3 //e.g 18.3
4 Rb=180*10**3;
5 Vcc=25;
6 Rc=820;
7 beta=80;
8 Ib=Vcc/Rb;//saturation current
9 disp( 'mA',Ib*10**3,"Ib=");
10 Ic=beta*Ib;
11 disp( 'mA',Ic*10**3,"Ic=");
12 Vce=Vcc-(Ic*Rc);//cut-off voltage
13 disp( 'V',Vce*1,"Vce=");

```

---

#### Scilab code Exa 18.4 RB and VCE

```

1
2 clc;
3 //e.g 18.4;
4 Vcc=12;
5 Rc=330;
6 Ib=0.3*10**-3;
7 beta=100;
8 //Ib=Vcc/Rb;//saturation current
9 Rb=Vcc/Ib;
10 disp( 'Kohm',Rb*10**-3,"Rb=");
11 S=1+beta;
12 disp(S);
13 Ic=beta*Ib;
14 disp( '10^-3A',Ic*10**3,"Ic=");
15 Vce=Vcc-(Ic*Rc);//cut-off voltage
16 disp( 'V',Vce*1,"Vce=");

```

---

### Scilab code Exa 18.5 voltage and current

```
1
2 clc;
3 //e.g 18.5
4 Rb=400*10**3;
5 Vcc=20;
6 Rc=2*10**3;
7 Re=1*10**3;
8 beta=100;
9 Ib=Vcc/(Rb+(beta*Re)); //saturation current
10 disp('mA', Ib*10**3, "Ib=");
11 Ic=beta*Ib;
12 disp('mA', Ic*10**3, "Ic=");
13 Vce=Vcc-(Ic*(Rc+Re)); //cut-off voltage
14 disp('V', Vce*1, "Vce=");
```

---

### Scilab code Exa 18.6 find Ic and Vce

```
1 clc;
2 //e.g 18.1
3 Vcc=12;
4 Rc=2.2*10**3;
5 Rb=240;
6 B=50;
7 Vbe=0.7;
8 RE=0;
9 Ic=(Vcc-Vbe)/(RE+(Rb/B)); //collector current
10 disp('mA', Ic, "Ic=");
11 Vce=Vcc-(Ic*10**-3)*Rc; //CE voltage
12 disp('V', Vce*1, "Vce=");
13 Icsat=Vcc/Rc;
14 disp('mA', Icsat*10**3, "Icsat=");
```

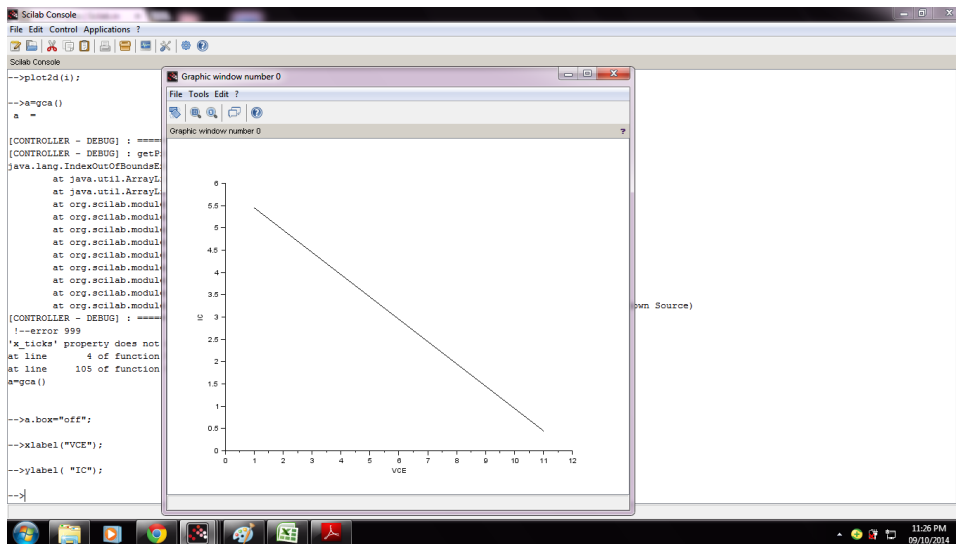


Figure 18.3: find  $I_c$  and  $V_{ce}$

```

15 Vce=Vcc; //cutoff voltage
16 i=5.45:-0.5:0;
17 plot(i);
18 a=gca() //get the current axes
19 a.box=" off ";
20 xlabel("VCE");
21 ylabel(" IC");

```

---

Scilab code Exa 18.7 load line

```

1 clc;
2 //e.g 18.7
3 Vcc=30;

```

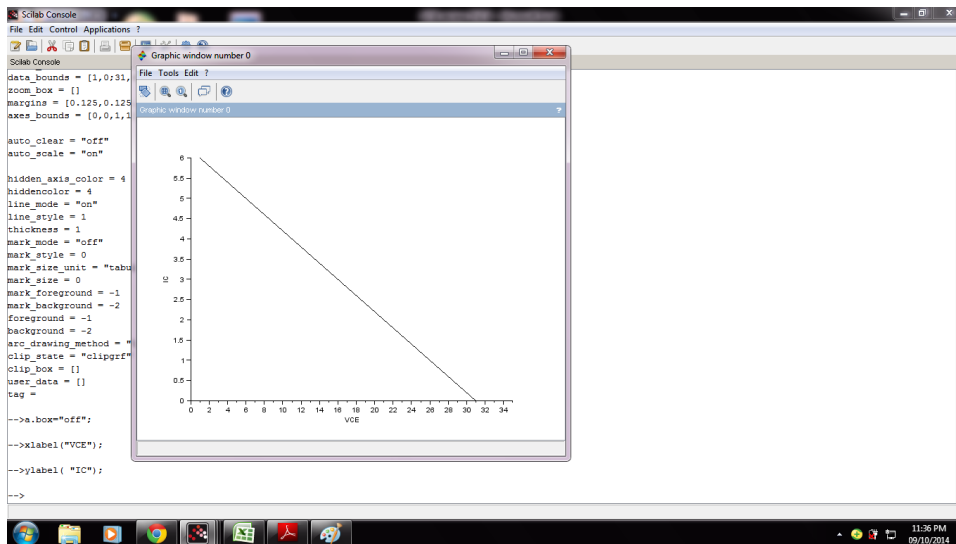


Figure 18.4: load line

```

4 Rb=1.5*10**6;
5 Rc=5*10**3;
6 beta=100;
7 Ic=Vcc/Rc; //saturation current
8 disp('mA',Ic*10**3,"Ic=");
9 Vce=Vcc; //cut-off voltage
10 disp('V',Vce*1,"Vce=");
11 Ib=Vcc/Rb; //base current
12 disp('microA',Ib*10**6,"Ib=");
13 Ic=beta*Ib;
14     disp('mA',Ic*10**3,"Ic=");
15     Vce=Vcc-Ic*Rc;
16     disp('V',Vce*1,"Vce=");
17 i=6:-0.2:0;
18 plot2d(i);
19 a=gca() //get the current axes
20 a.box="off";

```



```
21 xlabel("VCE");
22 ylabel("IC");
```

---

### Scilab code Exa 18.9 current voltage and stability factor

```
1
2
3 clc;
4 //e.g 18.9
5 Rb=180*10**3;
6 Vcc=25;
7 Rc=820;
8 Re=200;
9 beta=80;
10 Vbe=0.7;
11 Ic=(Vcc-Vbe)/(Re+(Rb/beta)); //collector current
12 disp('mA',Ic*10**3,"Ic=");
13 Vce=Vcc-(Ic*Rc); //collector to emitter voltage
14 disp('V',Vce*1,"Vce=");
15 S=(1+beta)/(1+beta*(Re/(Re+Rb)));
16 disp(S,"S="); //stability factor
```

---

### Scilab code Exa 18.10 Q point

```
1
2 clc;
3 //e.g 18.10
4 Vbe=0.7;
5 Rb=100*10**3;
6 Vcc=10;
7 Rc=10*10**3;
8 beta=100;
9 Ic=(Vcc-Vbe)/(Rc+(Rb/beta)); //collector current
```

```

10 disp('mA', Ic*10**3, " Ic=");
11 Vce=Vcc-(Ic*Rc); //collector to emitter voltage
12 disp('V', Vce*1, " Vce=");
13 Ic=Vcc/Rc;
14 disp('mA', Ic*10**3, " Ic=");
15 Vce=Vcc;
16 disp('V', Vce*1, " Vce=");

```

---

#### Scilab code Exa 18.11 IB IC AND IE

```

1
2
3 clc;
4 //e.g 18.11
5 Rb=100*10**3;
6 Vcc=10;
7 Rc=2*10**3;
8 beta1=50;
9 Vbe=0.7;
10 Ib=(Vcc-Vbe)/(Rb+(beta1*Rc));
11 disp('mA', Ib*10**3, " Ib=");
12 Ic=beta1*Ib;
13 disp('mA', Ic*10**3, " Ic=");
14 Ie=Ic;
15 disp('mA', Ie*10**3, " Ie=");

```

---

#### Scilab code Exa 18.12 possible causes

```

1
2 clc;
3 //e.g 18.12
4 VCC=9;
5 RB=220*10**3;

```

```

6 RC=3.3*10**3;
7 VBE=0.3;
8 B=100;
9 // if vc=0
10 IB=(VCC-VBE)/(RB+(B*RC));
11 disp('microA',IB*10**6,"IB=");
12 IC=B*IB;
13 disp('microA',IC*10**6,"IC="); //CORRECTION IN BOOK
14 // if VC=9
15 VC=9;
16 IC=B*IB;
17 disp('mA',IC*10**3,"IC=");
18 //IC*RC=0,which means collector resistance is short
   circuited

```

---

#### Scilab code Exa 18.13 find R1

```

1
2 clc;
3 //e.g 18.13
4 Vcc=12;
5 Rc=3.3*10**3;
6 Re=100;
7 Ie=2*10**-3;
8 Vbe=0.7;
9 alpha=0.98;
10 Ic=alpha*Ie;
11 disp('mA',Ic*10**3,"Ic=");
12 Vb=Vbe+(Ie*Re);
13 disp('V',Vb*1,"Vb=");
14 Vc=Vcc-(Ic*Rc); //collector to emitter voltage
15 disp('V',Vc*1,"Vc=");
16 R2=20*10**3;
17 IR2=Vc/R2;
18 disp('mA',IR2*10**3,"IR2=");

```

```

19 Ib=Ie-Ic;
20 disp('mA',Ib*10**3,"Ib=");
21 IR1=IR2+Ib;
22 disp('mA',IR1*10**3,"IR1=");
23 R1=(Vc-Vb)/IR1;
24 disp('kohm',R1*10**-3,"R1=");

```

---

#### Scilab code Exa 18.14 base resistance

```

1 clc;
2 VCC=24;
3 RC=10*10**3;
4 RE=270;
5 VBE=0.7;
6 B=45;
7 VCE=5;
8 IC=(VCC-VCE)/RC;
9 disp('mA',IC*10**3,"IC=");
10 RB=(2.6*10^3)*B;
11 disp('kohm',RB*10**-3,"RB=")

```

---

#### Scilab code Exa 18.15 dc bias current and voltage

```

1
2 clc;
3 //e.g 18.15
4 Rb=33*10**3;
5 Vcc=3;
6 Rc=1.8*10**3;
7 beta=90;
8 Vbe=0.7;
9 Ib=(Vcc-Vbe)/(Rb+(Rc*beta)); //collector current
10 disp('mA',Ib*10**3,"Ib=");

```

```

11 Ic=beta*Ib;
12 disp('mA',Ic*10**3,"Ic=");
13 Vce=Vcc-(Ic*Rc);//collector to emitter voltage
14 disp('V',Vce*1,"Vce=");
15 S=(1+beta)/(1+beta*(Rc/(Rc+Rb)));//stability factor

```

---

### Scilab code Exa 18.16 current and voltage

```

1
2 clc;
3 //e.g 18.16
4 Vbe=0.7;
5 Vcc=10;
6 Rc=1*10**3;
7 beta=100;
8 R1=10*10**3;
9 R2=5*10**3;
10 Re=500;
11 Vb=Vcc*(R2/(R1+R2));
12 disp('V',Vb*1,"Vb=");
13 Ve=Vb-Vbe;
14 disp('V',Ve*1,"Ve=");
15 Ie=Ve/Re;
16 disp('mA',Ie*10**3,"Ie=");
17 Ic=Ie;
18 disp('mA',Ic*10**3,"Ic=");
19 Vce=Vcc-(Rc+Re);
20 disp('V',Ve*1,"Ve=");

```

---

### Scilab code Exa 18.17 OPERATING POINT

```

1
2 clc;

```

```

3 //e.g 18.17
4 Vcc=9;
5 Rc=1*10**3;
6 Re=680;
7 beta=100;
8 R1=33*10**3;
9 R2=15*10**3;
10 Vb=Vcc*(R2/(R1+R2));
11 disp('V',Vb*1,"Vb=");
12 Vbe=0.7;
13 Ve=Vb-Vbe;
14 disp('V',Ve*1,"Ve=");
15 Ie=Ve/Re;
16 disp('mA',Ie*10**3,"Ie=");
17 Ic=Ie;
18 disp('mA',Ic*10**3,"Ic=");
19 VRc=Ic*Rc;
20 disp('V',VRc*1,"VRc=");
21 Vc=Vcc-VRc;
22 disp('V',Vc*1,"Vc=");
23 Vce=Vc-Ve;
24 disp('V',Vce*1,"Vce=");

```

---

### Scilab code Exa 18.18 R1 and RC

```

1
2 clc;
3 VCC=5;
4 RE=0.3*10**3;
5 IC=1*10**-3;
6 VCE=2.5;
7 B=100;
8 VBE=0.7;
9 ICO=0;
10 R2=10*10**3;

```

```

11 IE=IC;
12 RC=((VCC-VCE)/IC)-RE;
13 disp('ohm',RC*1,"RC=");
14 VE=IE*RE;
15 VB=VE+VBE;
16 R1=VCC*R2-R2;
17 disp('Kohm',R1*10**-3,"R1=");

```

---

### Scilab code Exa 18.19 IE and VCE

```

1
2 clc;
3 Vcc=20;
4 RC=1*10**3;
5 RE=5*10**3;
6 R1=10*10**3;
7 R2=10*10**3;
8 B=462;
9 VBE=0.7;
10 VB=Vcc*R2/(R1+R2);
11 disp('V',VB*1,"VB=");
12 VE=VB-VBE;
13 IE=VE/RE;
14 disp('mA',IE*10**3,"IE=");
15 IC=IE;
16 VCE=Vcc-IC*RC;
17 disp('V',VCE*1,"VCE=");

```

---

### Scilab code Exa 18.20 base current

```

1
2 clc;
3 VCC=8;

```

```

4 VRC=0.5;
5 RC=800;
6 a=0.96;
7 VCE=VCC-VRC; //VRC=IC*RC
8 IC=VRC/RC;
9 disp('mA', IC*10**3, "IC=");
10 IE=IC/a;
11 disp('mA', IE*10**3, "IE=");
12 IB=IE-IC;
13 disp('microA', IB*10**6, "IB=");

```

---

Scilab code Exa 18.21 change in collector current

```

1
2 clc;
3 VCC=12;
4 RC=1*10**3;
5 RE=100;
6 R1=25*10**3;
7 R2=5*10**3;
8 B=50;
9 VBE=0.6;
10 VTH=VCC*R2/(R1+R2);
11 RTH=R1*R2/(R1+R2);
12 IE50=(VTH-VBE)/(RE+RTH/B);
13 B=150;
14 IE150=(VTH-VBE)/(RE+RTH/B);
15 ICdiff=(IE150-IE50)/IE50;
16 disp('%', ICdiff*100, "ICdiff=")

```

---

Scilab code Exa 18.24 value of resistors

```

1 clc;

```



```

2 B=50;
3 VBE=0.7;
4 VCC=22.5;
5 RC=5.6*10**3;
6 VCE=12;
7 IC=1.5*10**-3;
8 S=3;
9 RE=(VCC-IC*RC-VCE)/IC;
10 disp('kohm',RE*10^-3,"RE=");
11 RTH=(4375)-RE;
12 disp('kohm',RTH*10^-3,"RTH=");
13 R2=0.1*B*RE;
14 disp('kohm',R2*10^-3,"R2=");
15 R1=(-RTH*R2)/(RTH-R2);
16 disp('kohm',R1*10^-3,"R1=");

```

---

#### Scilab code Exa 18.25 CURRENT AND VOLTAGE

```

1
2 clc;
3 VCC=10;
4 VEE=10;
5 RC=1*10**3;
6 RE=5*10**3;
7 RB=50*10**3;
8 VBE=0.7;
9 VE=-VBE;
10 IE=(VEE-VBE)/RE;
11 disp('mA',IE*10**3,"IE=");
12 IC=IE;
13 disp('mA',IC*10**3,"IC=");
14 VC=VCC-IC*RC;
15 VCE=VC-VE;
16 disp('volts',VCE*1,"VCE=");

```

---

Scilab code Exa 18.26 change in Q point

```
1  clc;
2  VCC=20;
3  VEE=20;
4  RC=5*10**3;
5  RE=10*10**3;
6  RB=10*10**3;
7  B1=50;
8  B2=100;
9  VBE1=0.7;
10 VBE2=0.6;
11 IE1=(VEE-VBE1)/(RE+RB/B1);
12 disp('mA', IE1*10**3, "IE1=");
13 IC1=IE1;
14 VC1=VCC-IC1*RC;
15 disp('V', VC1, "VC1=");
16 VE=-VBE1;
17 VCE1=VC1-VE;
18 disp('V', VCE1, "VCE1=");
19 IE2=(VEE-VBE2)/(RE+RB/B2);
20 disp('mA', IE2*10**3, "IE2=");
21 IC2=IE2;
22 VC2=VCC-IC2*RC;
23 disp('V', VC2, "VC2=");
24 VE=-VBE2;
25 VCE2=VC2-VE;
26 disp('V', VCE2, "VCE2=");
27 delIc=(IC2-IC1)/IC1;
28 disp('%', delIc*100, "delIc=");
29 delVCE=(VCE1-VCE2)/VCE2;
30 disp('%', delVCE*100, "delVCE=");
```

---

### Scilab code Exa 18.27 VOLTAGE AND CURRENT

```
1
2 clc;
3 VCC=12;
4 RC=2*10**3;
5 RE=1*10**3;
6 R1=100*10**3;
7 R2=20*10**3;
8 B=100;
9 VBE=-0.2;
10 VB=-VCC*R2/(R1+R2);
11 disp('V',VB*1,"VB=");
12 VE=VB-VBE;
13 disp('V',VE*1,"VE=");
14 IE=-VE/RE;
15 IC=IE;
16 disp('mA',IC*10**3,"IC=");
17 VC=-(VCC-IC*RC);
18 disp('V',VC*1,"VC=");
19 VCE=VC-(VE);
20 disp('V',VCE*1,"VCE=");
```

---

### Scilab code Exa 18.28 Quiescent points

```
1 clc;
2 VCC=4.5;
3 RC=1.5*10**3;
4 RE=0.27*10**3;
5 R2=2.7*10**3;
6 R1=27*10**3;
7 B=44;
```

```
8 VBE=-0.3;
9 VB=-VCC*R2/(R1+R2);
10 disp('V',VB*1,"VB=");
11 VE=VB-VBE;
12 disp('V',VE*1,"VE=");
13 IE=-VE/RE;
14 IC=IE;
15 disp('mA',IC*10**3,"IC=");
16 VRC=IC*RC;
17 disp('V',VRC*1,"VRC=");
18 VC=-[VCC-VRC]
19 disp('V',VC*1,"VC=");
20 VCE=VC-(VE);
21 disp('V',VCE*1,"VCE=");
```

---

# Chapter 19

## SINGLE STAGE BJT AMPLIFIERS

Scilab code Exa 19.1 resistance and voltage gain

```
1  clc;
2  //e.g 19.1
3  Vcc=10;
4  Rc=10*10**3;
5  Rb=1*10**6;
6  beta=100;
7  Vbe=0.7;
8  Ib=(Vcc-Vbe)/Rb;
9  disp('microA',Ib*10**6,"Ib=");
10 Ic=beta*Ib;
11 disp('mA',Ic*10**3,"Ic=");
12 Ie=Ic;
13 re=25/(Ie*10**3);
14 disp('ohm',re*1,"re=");
15 Ri=beta*re;
16 disp('kohm',Ri*10**-3,"Ri=");
17 Ris=(Rb*beta*re)/(Rb+beta*re);
18 disp('kohm',Ris*10**-3,"Ris=");
19 R0=Rc;
```

```
20 disp('kOhm',R0*10**-3,'R0=');
21 Av=Rc/re;
22 disp(Av);
```

---

### Scilab code Exa 19.2 current and gain

```
1 clc;
2 //e.g 19.2
3 Ri=2.5*10**3;
4 Av=200;
5 Vs=5*10**-3;
6 beta=50;
7 ib=(Vs/Ri)
8 disp('microA',ib*10**6,'ib=');
9 ic=beta*ib;
10 disp('microA',ic*10**6,'ic=');
11 Ai=beta;
12 Ap=Ai*Av;
13 disp(Ap);
14 Gp=10*log10(Ap);
15 disp('dB',Gp*1,'Gp=');
```

---

### Scilab code Exa 19.3 resistance and gain

```
1 clc;
2 //e.g 19.3
3 Vcc=20;
4 Rc=5*10**3;
5 Re=1*10**3;
6 Rb=100*10**3;
7 beta=150;
8 Vbe=0.7;
9 Ic=Vcc/(Re+(Rb/beta));
```

```

10 disp('mA', Ic*10**3, "Ic=");
11 Ie=Ic;
12 re=25/(Ie*10**3);
13 disp('ohm', re*1, "re=");
14 Ri=beta*(re+Re);
15 disp('kohm', Ri*10**-3, "Ri=");
16 Ris=(Rb*Ri)/(Rb+Ri);
17 disp('kohm', Ris*10**-3, "Ris=");
18 Av=Rc/Re;
19 disp(Av);
20 Gp=10*log10(Av);
21 disp('dB', Gp*1, "Gp=");

```

---

#### Scilab code Exa 19.4 voltage gain and resistance

```

1 clc;
2 //e.g 19.4
3 Vcc=12;
4 Rc=10*10**3;
5 Re=1*10**3;
6 Rb=500*10**3;
7 beta=50;
8 Ic=Vcc/(Re+(Rb/beta));
9 disp('mA', Ic*10**3, "Ic=");
10 Ie=Ic;
11 re=25/(Ie*10**3);
12 disp('ohm', re*1, "re=");
13 Ri=beta*re;
14 disp('ohm', Ri*1, "Ri=");
15 Ris=(Rb*Ri)/(Rb+Ri);
16 disp('ohm', Ris*1, "Ris=");
17 R0=Rc;
18 Av=R0/re;
19 disp(Av);
20 Av=Rc/Re;

```

```
21 disp(Av);
```

---

### Scilab code Exa 19.5 voltage and impedance

```
1 clc;
2 //e.g 19.5
3 Vcc=30;
4 Rc=10*10**3;
5 RL=3.3*10**3;
6 R1=47*10**3;
7 R2=15*10**3;
8 Re=8.2*10**3;
9 beta=200;
10 Vs=5*10**-3;
11 Vbe=0.7;
12 Vth=(Vcc*R2)/(R1+R2);
13 disp('V',Vth*1,"Vth=");
14 Rth=(R1*R2)/(R1+R2);
15 disp('10^3ohm',Rth*10**-3,"Rth=");
16 Ie=(Vth-Vbe)/(Re+(Rth/beta));
17 disp('mA',Ie*10**3,"Ie=");
18 re=25/(Ie*10**3);
19 disp('ohm',re*1,"re=");
20 rl=(Rc*RL)/(Rc+RL);
21 disp('Kohm',rl*10**-3,"rl=");
22 Av=rl/re;
23 disp(Av);
24 Vin=5;
25 V0=Av*Vin
26 disp('mV',V0*1,"V0=");
27 Ri=beta*re;
28 disp('Kohm',Ri*10**-3,"Ri=");
29 Ris=(Rth*Ri)/(Rth+Ri);
30 disp('Kohm',Ris*10**-3,"Ris=");
```

---



### Scilab code Exa 19.6 output voltage and output gain

```
1  clc;
2  //e.g 19.6
3  Vcc=10;
4  Rc=5*10**3;
5  Re=1*10**3;0
6  RL=50*10**3;
7  R1=50*10**3;
8  R2=10*10**3;
9  Rs=600;
10 beta=50;
11 Vs=10*10**-3;
12 Vbe=0.7;
13 Vth=(Vcc*R2)/(R1+R2);
14 disp('V',Vth*1,"Vth=");
15 Rth=(R1*R2)/(R1+R2);
16 disp('10^3ohm',Rth*10**-3,"Rth=");
17 Ie=(Vth-Vbe)/(Re+(Rth/beta));
18 disp('mA',Ie*10**3,"Ie=");
19 re=25/(Ie*10**3);
20 disp('ohm',re*1,"re=");
21 Ri=beta*re;
22 Ris=(Rth*Ri)/(Rth+Ri);
23 disp('ohm',Ris*1,"Ris=");
24 rl=(Rc*RL)/(Rc+RL);
25 disp('Kohm',rl*10**-3,"rl=");
26 Av=rl/re;
27 disp(Av);
28 Vin=(Vs*Ris)/(Ris+Rs);
29 disp('mV',Vin*10**3,"Vin=");
30 V0=Av*Vin;
31 disp('mV',V0*1,"V0=");
32 Avs=(Av*Vin)/Vs;
```

```
33 disp(Avs);
```

---

### Scilab code Exa 19.7 voltage and impedance

```
1 clc;
2 //e.g 19.7
3 Vcc=-18;
4 Rc=4.3*10**3;
5 Re=1*10**3;0
6 RL=3*10**3;
7 R1=39*10**3;
8 R2=8.2*10**3;
9 beta1=200;
10 Vbe=-0.7;
11 Vth=(Vcc*R2)/(R1+R2);
12 disp('V',Vth*1,"Vth=");
13 Rth=(R1*R2)/(R1+R2);
14 disp('kohm',Rth*10**-3,"Rth=");
15 Ie=(Vth-Vbe)/(Re+(Rth/beta1));
16 disp('mA',Ie*10**3,"Ie=");
17 re1=(30*10**-3)/(-Ie);
18 disp('ohm',re1*1,"re1=");
19 re=(Rc*RL)/(Rc+RL);
20 Ri=beta1*re;
21 Ris=(Rth*Ri)/(Rth+Ri);
22 disp('kohm',Ris*10**-3,"Ris=");
23 disp('Kohm',re*10**-3,"re=");
24 Av=re/re1;
25 disp(Av);
```

---

### Scilab code Exa 19.8 Av Ri Ro and Avs

```
1 clc;
```

```

2 //e.g 19.8
3 Vs = 200
4 Vcc=20;
5 Rc=5.7*10**3;
6 Re=1*10**3;
7 R1=100*10**3;
8 R2=10*10**3;
9 Rs=100;
10 beta1=100;
11 Vbe=0.7;
12 Vth=(Vcc*R2)/(R1+R2);
13 disp('V',Vth*1,"Vth=");
14 Rth=(R1*R2)/(R1+R2);
15 disp('Kohm',Rth*10**-3,"Rth=");
16 Ie=(Vth-Vbe)/(Re+(Rth/beta1));
17 disp('mA',Ie*10**3,"Ie=");
18 re=25/(Ie*10**3);
19 disp('ohm',re*1,"re=");
20 Ri=beta1*re;
21 Ris=(Rth*Ri)/(Rth+Ri);
22 disp('ohm',Ris*1,"Ris=");
23 rl=Rc;
24 Av=rl/re;
25 disp(Av);
26 Vin=(Vs*Ris)/(Ris+Rs);
27 disp('mV',Vin*1,"Vin=");
28 V0=Av*Vin;
29 disp('V',V0*10**-3,"V0=");
30 Avs=(Av*Vin)/Vs;
31 disp(Avs);

```

---

### Scilab code Exa 19.9 GAIN VOLTAGE AND RESISTANCE

```

1 clc;
2 //e.g 19.9

```

```

3 Vcc=10;
4 Rc=5*10**3;
5 RE1=500;
6 R1=50*10**3;
7 R2=10*10**3;
8 Rs=600;
9 rE=500;
10 beta1=50;
11 Vbe=0.7;
12 vs=100*10**-3;
13 Rl=50*10**3;
14 Vth=(Vcc*R2)/(R1+R2);
15 disp('V',Vth*1,"Vth=");
16 Rth=(R1*R2)/(R1+R2);
17 disp('10^3ohm',Rth*10**-3,"Rth=");
18 RE=RE1+rE;
19 disp('ohm',RE*1,"RE=");
20 Ie=(Vth-Vbe)/(RE+(Rth/beta1));
21 disp('mA',Ie*10**3,"Ie=");
22 re=25/(Ie*10**3);
23 disp('ohm',re*1,"re=");
24 Ri=beta1*(re+rE);
25 disp('Kohm',Ri*10**-3,"Ri=");
26 Ris=(Rth*Ri)/(Rth+Ri);
27 disp('ohm',Ris*1,"Ris=");
28 rl=(Rc*Rl)/(Rc+Rl)
29 disp('kohm',rl*10**-3,"rl=");
30 Av=rl/(re+rE);
31 disp(Av);
32 VinBYVs=(Ris)/(Ris+Rs);
33 disp('V',VinBYVs*1,"VinBYVs=");
34 Avs=Av*VinBYVs;
35 disp(Avs);
36 V0=Avs*vs;
37 disp('mV',V0*10^3,"V0="); //answer printed in the
    book is wrong(variation in decimal point)

```

---

Scilab code Exa 19.10 resistance voltage gain current gain power gain

```
1  clc;
2  VS=10*10**-3;
3  a=0.98;
4  VBE=0.7;
5  VCC=10;
6  RC=10*10**3;
7  RL=5.1*10**3;
8  RE=20*10**3;
9  VEE=10;
10 IE=(VEE-VBE)/RE;
11 re=25/IE*10**-3;
12 Ri=re;
13 Ris=(RE*re)/(RE+re);
14 disp('ohm',Ris,"Ris=");
15 Ai=a;
16 disp(Ai);
17 rL=(RC*RL)/(RC+RL);
18 Av=rL/re;
19 disp(Av);
20 Ap=Av*Ai;
21 disp(Ap);
22 Gp=10*log10(Ap);
23 disp('dB',Gp,"Gp=");
24 Vin=VS;
25 Vo=Av*Vin;
26 disp('mV',Vo*10**3,"Vo=");
```

---

Scilab code Exa 19.11 VOLTAGE GAIN

```
1  clc;
```

```

2 Rs=50;
3 IE=0.465*10**-3;
4 re1=53.8;
5 Ri=53.8;
6 Ris=52.4;
7 rL=3.38*10**3;
8 Avs=rL/(Rs+re1);
9 disp(Avs);
10 Av=rL/re1;
11 disp(Av);
12 Vs=10;
13 vo=Avs*Vs;
14 vin=vo/Av;
15 disp('mV',vin,"vin=");

```

---

#### Scilab code Exa 19.12 resistance and voltage gain

```

1 clc;
2 VEE=10;
3 RE=10*10**3;
4 RB=100*10**3;
5 B=50;
6 VBE=0.7;
7 IE=(VEE-VBE)/(RE+(RB/B));
8 re=25/IE*10**-3;
9 Ri=B*(RE+re);
10 disp('Kohm',Ri*10**-3,"Ri=");
11 Ris=(RB*Ri)/(RB+Ri);
12 Rs=0;
13 Ro=re+((RB*Rs)/(RB+Rs))/B;
14 disp('ohm',Ro,"Ro=");
15 Av=RE/(re+RE);
16 disp(Av);

```

---

### Scilab code Exa 19.13 resistance and voltage

```
1  clc;
2  B=80;
3  VBE=0.7;
4  VCC=15;
5  R1=20*10**3;
6  R2=20*10**3;
7  RS=2*10**3;
8  VS=5*10**-3;
9  RE=8.2*10**3;
10 RL=1.5*10**3;
11 VTH=VCC*R2/(R1+R2);
12 RTH=(R1*R2)/(R1+R2);
13 IE=(VTH-VBE)/(RE+(RTH/B));
14 disp('mA', IE*10**3, "IE=");
15 re=25/IE*10**-3;
16 rL=(RE*RL)/(RE+RL);
17 Ri=B*(rL+re);
18 Ris=(RTH*Ri)/(RTH+Ri);
19 disp('kohm', Ris*10**-3, "Ris=");
20 Ro=re+((RS*RTH)/(RS+RTH))/B;
21 disp('ohm', Ro, "Ro=");
22 Vin=VS*Ris/(RS+Ris);
23 disp('mV', Vin*10**3, "Vin=");
```

---

# Chapter 20

## HYBRID PARAMETERS

Scilab code Exa 20.2 Impedance voltage and current gain

```
1  clc;
2  hie=1.0*10**3;
3  hre=1*10**-4;
4  hoe=100*10**-6;
5  RC=1000;
6  RS=1000;
7  rL=RC;
8  hfe=50;
9  Ai=-hfe/(1+hoe*rL);
10 Ri=hie+hre*Ai*rL;
11 Ris=Ri;
12 disp('Ohm',Ris*1,"Ris=");
13 delh=hie*hoe-hre*hfe;
14 his=1000;
15 Ro=(RS+his)/(RS*hoe+delh);
16 disp('kOhm',Ro*10**-3,"Ro=");
17 Ros=(Ro*rL)/(Ro+rL);
18 disp('Ohm',Ros*1,"Ros=");
19 Ais=(Ai*RS)/(RS+Ris);
20 disp(Ais);
21 Av=(Ai*rL)/Ri;
```



```
22 Avs=(Av*Ris)/(RS+Ris);
23 disp(Avs);
```

---

Scilab code Exa 20.3 impedance current and voltage gain

```
1 clc;
2 hie=1.1*10**3;
3 hre=2.5*10**-4;
4 hfe=50;
5 hoe=25*10**-6;
6 rs=1*10**3;
7 rL=1*10**3;
8 Ai=hfe/(1+hoe*rL);
9 disp(Ai);
10 Ri=hie+hre*Ai*rL;
11 disp('Ohm',Ri*1," Ri=");
12 Av=(Ai*rL)/Ri;
13 disp(Av);
```

---

Scilab code Exa 20.4 voltage gain and resistance

```
1 clc;
2 RC=4*10**3;
3 RB=40*10**3;
4 RS=10*10**3;
5 hie=1100;
6 hfe=50;
7 hre=0;
8 hoe=0;
9 RB2=40*10**3;
10 rL=(RC*RB2)/(RC+RB2);
11 Ai=-hfe/(1+hoe*rL);
12 Ri=hie+hre*Ai*rL;
```

```

13 Av=(Ai*rL)/Ri;
14 RB1=40*10**3/(1-Av);
15 Ris=(Ri*RB1)/(Ri+RB1);
16 disp('ohm',Ris*1,"Ris=");
17 Ros=rL;//Ro=infinity
18 disp('Ohm',Ros*1,"Ros=");
19 Avs=(Av*Ris)/(RS+Ris);
20 disp(Avs);

```

---

Scilab code Exa 20.5 resistance voltage and current gain

```

1 clc;
2 hib=28;
3 hfb=-0.98;
4 hrb=5*10**-4;
5 hob=0.34*10**-6;
6 rL=1.2*10**3;
7 Rs=0;
8 Ai=-hfb/(1+hob*rL);
9 disp(Ai);
10 Ri=hib+hrb*Ai*rL;
11 disp('Ohm',Ri*1,"Ri=");
12 delh=hib*hob-hrb*hfb;
13 Ro=(Rs+hib)/(Rs*hib+delh);
14 disp('kOhm',Ro*10**-3,"Ro=");
15 Av=(Ai*rL)/Ri;
16 disp(Av);

```

---

Scilab code Exa 20.6 resistance voltage and current gain

```

1 clc;
2 hic=2*10**3;
3 hfc=-51;

```

```

4 hrc=1;
5 hoc=25*10**-6;
6 rL=5*10**3;
7 RE=5*10**3;
8 Rs=1000;
9 R1=10*10**3;
10 R2=10*10**3;
11 Ai=-hfc/(1+hoc*rL);
12 disp(Ai);
13 Ri=hic+hrc*Ai*rL;
14 disp('kOhm',Ri*10**-3," Ri=");
15 a=(R1*R2)/(R1+R2);
16 Ris=(Ri*a)/(Ri+a);
17 disp('Ohm',Ris*1," Ris=");
18 Ro=-(Rs+hic)/hfc;
19 Ros=(Ro*RE)/(Ro+RE);
20 disp('Ohm',Ros*1," Ros=");
21 Ais=(Ai*Rs)/(Rs+Ris);
22 disp(Ais);
23 Av=(Ai*rL)/Ri;
24 disp(Av);
25 Avs=(Av*Ris)/(Rs+Ris);
26 disp(Avs);

```

---

Scilab code Exa 20.7 resistance voltage and current gain

```

1 clc;
2 hie=1500;
3 hfe=50;
4 hre=50*10**-4;
5 hoe=20*10**-6;
6 RC=5*10**3;
7 RL=10*10**3;
8 R1=20*10**3;
9 R2=10*10**3;

```

```

10 rL=(RC*RL)/(RC+RL);
11 Ai=-hfe;
12 Ri=hie;
13 a=(R1*R2)/(R1+R2);
14 Ris=(Ri*a)/(Ri+a);
15 disp('kOhm',Ris*10**-3,"Ris=");
16 Ro=1/hoe;
17 Ros=(Ro*rL)/(Ro+rL); // correction
18 disp('kOhm',Ros*10**-3,"Ros=");
19 Avs=(Ai*rL)/Ri;
20 disp(Avs);
21 Ais=Ai; // correction
22 disp(Ais);

```

---

#### Scilab code Exa 20.8 voltage and impedance

```

1
2 clc;
3 RC=12*10**3;
4 RL=4.7*10**3;
5 R1=33*10**3;
6 R2=4.7*10**3;
7 IC=1*10**-3;
8 hiemin=1*10**3;
9 hiemax=5*10**3;
10 hfemin=70;
11 hfemax=350;
12 hie=sqrt(hiemin*hiemax);
13 disp('kOhm',hie*10**-3,"hie=");
14 hfe=sqrt(hfemin*hfemax);
15 disp('Ohm',hfe*1,"hfe="); // answer printed in the
    book is wrong
16 Ri=hie;
17 a=(R1*R2)/(R1+R2);
18 Ris=(Ri*a)/(Ri+a);

```

```

19 disp('kOhm',Ris*10**-3,"Ris=");
20 Ai=hfe;
21 rc=(RC*RL)/(RC+RL);
22 Avs=(Ai*rc)/Ri;
23 disp(Avs,"Avs=");

```

---

Scilab code Exa 20.9 resistance voltage and current gain

```

1 clc;
2 RB=330*10**3;
3 RC=2.7*10**3;
4 hfe=120;
5 hie=1.175*10**3;
6 hoe=20*10**-6;
7 Ri=hie;
8 Ris=(hie*RB)/(hie+RB);
9 disp('kohm',Ris*10**-3,"Ris=");
10 Ro=1/hoe;
11 Ros=(Ro*RC)/(Ro+RC);
12 disp('kohm',Ros*10**-3,"Ros=");
13 Ai=hfe;
14 disp(Ai);
15 Av=(hfe*RC)/Ri;
16 disp(Av);

```

---

Scilab code Exa 20.10 hfb and hfc

```

1 clc;
2 hfe=50;
3 hfb=-hfe/(1+hfe);
4 disp(hfb);
5 hfc=-(1+hfe);
6 disp(hfc);

```

---

Scilab code Exa 20.11 gain and input resistance

```
1  clc;
2  hie=1100;
3  hre=2.5*10**-4;
4  hfe=50;
5  hoe=24*10**-6;
6  rL=10*10**3;
7  RS=1*10**3;
8  hic=hie;
9  hrc=1-hre;
10 hfc=-(1+hfe);
11 Ai=hfc/(1+hoe*rL);
12 disp(Ai);
13 Ri=hie+hrc*-Ai*rL;
14 disp('kOhm',Ri*10**-3,' Ri=');
15 Av=(-Ai*rL)/Ri;
16 disp(Av);
```

---

# Chapter 21

## MULTISTAGE BJT AMPLIFIERS

Scilab code Exa 21.1 total voltage gain

```
1  clc;
2  Av1=10;
3  Av2=20;
4  Av3=40;
5  Av=Av1*Av2*Av3;
6  disp(Av);
7  GV1=20*log10(Av1);
8  GV2=20*log10(Av2);
9  GV3=20*log10(Av3);
10 GV=GV1+GV2+GV3; //CORRECTION
11 disp('dB',GV*1,"GV=");
```

---

Scilab code Exa 21.2 voltage gain and input voltage of 2nd stage

```
1  clc;
2  vin1=0.05;
```

```

3 vout3=150;
4 Av1=20;
5 vin3=15;
6 Av=vout3/vin1;
7 disp(Av);
8 Av3=vout3/vin3;
9 disp(Av3);
10 Av2=Av/(Av3*Av1);
11 disp(Av2);
12 vin2=Av2/vin3;
13 disp('Vpk-pk ',vin2*1," vin2=");

```

---

Scilab code Exa 21.3 input resistance output resistance current and voltage gain

```

1 clc;
2 VCC=10;
3 Rc=5*10**3;
4 RB=1*10**6;
5 RE=1*10**3;
6 RL=10*10**3;
7 B1=100;
8 B2=100;
9 B=B1;
10 IE=VCC/(RE+(RB/B1));
11 re=25/(IE*10**3);
12 Ri1=B*re;
13 disp('ohm ',Ri1*1," Ri1=");
14 Ri2=B*re;
15 disp('ohm ',Ri2*1," Ri2=");
16 Ro1=(Rc*Ri2)/(Rc+Ri2);
17 disp('ohm ',Ro1*1," Ro1=");
18 Ro2=(Rc*RL)/(Rc+RL);
19 disp('ohm ',Ro2*1," Ro2=");
20 Av1=Ro1/re;
21 disp(Av1);

```



```

22 Av2=Ro2/re;
23 disp(Av2);
24 Av=Av1*Av2;
25 disp(Av);
26 Gv=20*log10(Av);
27 disp('dB',Gv*1,"Gv=");

```

---

### Scilab code Exa 21.4 voltage gain

```

1  clc;
2  VCC=15;
3  Rc=3.3*10**3;
4  RE=1000;
5  R1=33*10**3;
6  R2=8.2*10**3;
7  RL=10*10**3;
8  B=100;
9  VBE=0.7;
10 VTH=VCC*(R2/(R1+R2));
11 RTH=(R1*R2)/(R1+R2);
12 IE=(VTH-VBE)/(RE+(RTH/B));
13 re=25/(IE*10**3);
14 Ri2=B*re;
15 disp('ohm',Ri2*1,"Ri2="); //the answer of Ri2 varies
    from the answer printed in the book with slight
    difference(11.7 in book & 11.65 here),but this
    affects some answers further.
16 Ro1=(Rc*Ri2)/(Rc+Ri2);
17 disp('ohm',Ro1*1,"Ro1=");
18 Ro2=(Rc*RL)/(Rc+RL);
19 disp('ohm',Ro2*1,"Ro2=");
20 Av1=Ro1/re;
21 disp(Av1);
22 Av2=Ro2/re;
23 disp(Av2);

```

```
24 Av=Av1*Av2;
25 disp(Av);
26 Gv=20*log10(Av);
27 disp('dB',Gv*1,"Gv=");
```

---

### Scilab code Exa 21.5 cutoff frequency and voltage gain

```
1 clc;
2 bw=500*10**3;
3 Avmax=120;
4 f1=25;
5 f2=bw+f1;
6 disp('kHz',f2*10**-3,"f2=");
7 Av=Avmax/(sqrt(2))
8 disp(Av); //ans printed in the book is wrong
```

---

### Scilab code Exa 21.6 individual stage gains and voltage gain

```
1 clc;
2 VCC=10;
3 RB=470*10**3;
4 RE=1*10**3;
5 RL=1*10**3;
6 a=4;
7 B=50;
8 IE=VCC/(RE+(RB/B));
9 re=25/(IE*10**3);
10 Ri1=(RB*(B*re))/(RB+(B*re));
11 disp('ohm',Ri1*1,"Ri1=");
12 Ri2=(RB*(B*re))/(RB+(B*re));
13 disp('ohm',Ri2*1,"Ri2=");
14 RI2=(a^2)*Ri2;
15 R01=RI2;
```

```

16 RI2=(a^2)*RL;
17 Av1=R01/re;
18 disp(Av1);
19 R02=RI2;
20 Av2=R02/re;
21 disp(Av1);
22 Av=Av1*Av2;
23 disp(Av);
24 Gv=20*log10(Av);
25 disp('dB',Gv*1,"Gv=");

```

---

#### Scilab code Exa 21.7 voltage gain

```

1 clc;
2 VCC=12;
3 R1=100*10**3;
4 R2=20*10**3;
5 R3=10*10**3;
6 R4=2*10**3;
7 R5=10*10**3;
8 R6=2*10**3;
9 B=100;
10 B2=100;
11 VTH=VCC*(R2/(R1+R2));
12 IE1=VTH/R4;
13 re1=25/IE1*10**-3;
14 VR6=VCC-IE1*R3;
15 IE2=VR6/R6;
16 re2=25/IE2*10**-3;
17 Ri2=B2*(re2+R6);
18 R01=(R3*Ri2)/(R3+Ri2);
19 R02=R5;
20 Av1=R01/(re1+R4);
21 disp(Av1);
22 Av2=R02/(re2+R6);

```

```
23 disp(Av2);
24 Av=Av1*Av2;
25 disp(Av);
```

---

Scilab code Exa 21.8 collector current VCE and ac voltage gain

```
1  clc;
2  VCC=10;
3  R1=800;
4  R2=200;
5  R3=600;
6  R4=200;
7  R5=100;
8  R6=1*10**3;
9  B=100;
10 B2=B;
11 VBE=0.7;
12 RE=200;
13 VR2=VCC*(R2/(R1+R2));
14 IE1=(VR2-VBE)/RE;
15 IC1=IE1;
16 disp('mA', IC1*10**3, "IC1=");
17 VC1=VCC-IC1*R3;
18 VE1=IE1*R4;
19 VCE1=VC1-VE1;
20 disp('V', VCE1*1, "VCE1=");
21 VE2=VC1-(-VBE);
22 IE2=(VCC-VE2)/R6;
23 IC2=IE2;
24 VC2=IC2*R5;
25 VCE2=VC2-VE2;
26 disp('V', VCE2*1, "VCE2=");
27 re1=25/IE1*10**-3;
28 re2=25/IE2*10**-3;
29 Ri2=B2*(re2+R6);
```

```

30 R01=(R3*Ri2)/(R3+Ri2);
31 Av1=R01/(re1+R4);
32 disp(Av1*1,"Av1=");
33 Av2=1;
34 disp(Av2*1,"Av2=");
35 Av=Av1*Av2;
36 disp(Av*1,"Av=");

```

---

### Scilab code Exa 21.9 gain emitter diode resistance

```

1  clc;
2  VCC=10;
3  R1=30*10**3;
4  R2=20*10**3;
5  RE=1.5*10**3;
6  B1=150;
7  B2=100;
8  VBE=0.7;
9  Ai=B1*B2;
10 disp(Ai);
11 VR2=VCC*(R2/(R1+R2));
12 VB2=VR2-VBE;
13 VE2=VB2-VBE;
14 IE2=VE2/RE;
15 re2=25/(IE2*10**3);
16 disp('ohm',re2*1,"re2=");
17 Ib2=IE2/B2;
18 IE1=Ib2;
19 re1=25/(IE1*10**3);
20 disp('ohm',re1*1,"re1=");
21 Ri1=(R1*R2)/(R1+R2);
22 disp('Kohm',Ri1*10**-3,"Ri1=");
23 Av=RE/((re1/B2)+(re2+RE));
24 disp(Av);

```

---

# Chapter 22

## FET AMPLIFIERS

Scilab code Exa 22.1 vdc vgs

```
1  clc;
2  //e.g 22.1
3  ID=5*10**-3;
4  VDD=10;
5  RD=1*10**3;
6  RS=500;
7  VS=ID*RS;
8  disp('V',VS*1,"VS=");
9  VD=VDD-ID*RD;
10 disp('V',VD*1,"VD=");
11 VDS=VD-VS;
12 disp('V',VDS*1,"VDS=");
13 VGS=-VS;
14 disp('V',VGS*1,"VGS=");
```

---

Scilab code Exa 22.2 R1

```
1  clc;
```

```

2 //e.g 22.2
3 RD=56*10**3;
4 RG=1*10**6;
5 IDSS=1.5*10**-3;
6 VP=-1.5;
7 VD=10;
8 VDD=20;
9 ID=VD/RD;
10 disp('mA', ID*10**3, "ID=");
11 //ID=IDSS*(1-(VGS/VP))**2
12 VGS=VP*(1-sqrt(ID/IDSS));
13 disp('V', VGS*1, "VGS=");
14 VS=VGS;
15 R1=(-VS/ID)-4*10**3;
16 disp('kohm', R1*10**-3, "R1=");

```

---

### Scilab code Exa 22.3 RS and RD

```

1 clc;
2 //e.g 22.3
3 ID=1.5*10**-3;
4 VDS=10;
5 IDSS=5*10**-3;
6 VP=-2;
7 VDD=20;
8 //ID=IDSS*(1-(VGS/VP))**2
9 VGS=VP*(1-(ID/IDSS));
10 VS=-VGS;
11 RS=(VS/ID);
12 disp('ohm', RS*1, "RS=");
13 RD=((VDD-VDS)/ID)-RS;
14 disp('Kohm', RD*10**-3, "RD=");

```

---

### Scilab code Exa 22.5 RD and RS

```
1  clc;
2  //e.g22.5
3  VP=5;
4  IDSS=12*10**-3;
5  VDD=12;
6  ID=4*10**-3;
7  VDS=6;
8  VGS=VP*(1-sqrt(ID/IDSS));
9  VS=VGS;
10 RS=VS/ID;
11 disp('ohm',RS*1,"RS=");
12 RD=VDS/ID;
13 disp('Kohm',RD*10**-3,"RD=")
```

---

### Scilab code Exa 22.6 self bias operation point

```
1  clc;
2  //e.g 22.6
3  IDSS=10*10**-3;
4  VDD=20;
5  IDQ=IDSS/2;
6  disp('mA',IDQ*10**3,"ID=");
7  VDSQ=VDD/2;
8  disp('V',VDSQ*1,"VDS=");
9  VGS=-2.2;
10 RD=(VDD-VDSQ)/IDQ;
11 disp('Kohm',RD*10**-3,"RD=");
12 RS=-VGS/IDQ;
13 disp('ohm',RS*1,"RS=")
```

---

### Scilab code Exa 22.7 VGS and VDS



```

1  clc;
2  //e.g 22.7
3  VDD=20;
4  RD=2.5*10**3;
5  RS=1.5*10**3;
6  R1=2*10**6;
7  R2=250*10**3;
8  ID=4*10**-3;
9  VG=(R2*VDD)/(R1+R2);
10 VS=ID*RS;
11 VGS=VG-VS;
12 disp('V',VGS*1,"VGS=");
13 VD=VDD-ID*RD;
14 VDS=VD-VS;
15 disp('V',VDS*1,"VDS=");

```

---

#### Scilab code Exa 22.8 voltage gain

```

1  clc;
2  //e.g22.8
3  gm=4*10**-3;
4  RD=1.5*10**3;
5  AV=-gm*RD;
6  disp(AV);

```

---

#### Scilab code Exa 22.9 voltage gain

```

1  clc;
2  //e.g 22.9
3  gm=2.5*10**-3;
4  rd=500*10**3;
5  RD=10*10**3;
6  rL=(RD*rd)/(rd+RD);

```

```
7 disp('10^3 ohm',rL*10**-3,"rL=");
8 AV=-gm*rL;
9 disp(AV);
```

---

#### Scilab code Exa 22.10 voltage gain

```
1 clc;
2 //e.g 22.10
3 gm=2*10**-3;
4 rd=40*10**3;
5 RD=20*10**3;
6 RG=100*10**6;
7 rL=(RD*rd)/(RD+rd);
8 Av=-gm*rL;
9 disp(Av);
10 Ri=RG;
11 disp('Mohm',Ri*10**-6,"Ri=");
12 Ro=rL;
13 disp('Kohm',Ro*10**-3,"Ro=");
```

---

#### Scilab code Exa 22.11 voltage gain

```
1 clc;
2 //e.g 22.11
3 gm=2*10**-3;
4 rd=10*10**3;
5 RD=50*10**3;
6 r1=(rd*RD)/(rd+RD);
7 Av=-gm*r1;
8 disp(Av);
```

---

### Scilab code Exa 22.12 voltage gain

```
1  clc;
2  //e.g 22.12
3  RD=100*10**3;
4  gm=1.6*10**-3;
5  rd=44*10**3;
6  Cgs=3*10**-12;
7  Cds=1*10**-12;
8  Cgd=2.8*10**-12;
9  rl=(RD*rd)/(RD+rd);
10 Av=-gm*rl;
11 disp(Av);
```

---

### Scilab code Exa 22.13 rms output voltage

```
1  clc;
2  //e.g 22.13
3  gm=4500*10**-6;
4  RD=3*10**3;
5  RL=5*10**3;
6  vin=100*10**-3;
7  ID=2*10**-3;
8  rl=(RD*RL)/(RD+RL);
9  VO=gm*rl*vin;
10 disp('V',VO*1,"VO=");
```

---

### Scilab code Exa 22.14 voltage gain

```
1  clc;
2  //e.g 22.14;
3  gm=4*10**-3;
4  RD=1.5*10**3;
```

```

5  RG=10*10**6;
6  rs=500;
7  rl=RD;
8  AV=-(gm*rl)/(1+gm*rs);
9  disp(AV);
10 RL=100*10^3;
11 rL=(RD*RL)/(RD+RL);
12 AV=-(gm*rL)/(1+gm*rs);
13 disp(AV);

```

---

Scilab code Exa 22.15 voltage gain

```

1  clc;
2  // e.g 22.15
3  RD=1.5*10**3;
4  RS=750;
5  RG=1*10**6;
6  IDSS=10*10**-3;
7  VP=-3.5;
8  IDQ=2.3*10**-3;
9  VGSQ=-1.8;
10 gmo=-2*IDSS/VP;
11 gm=gmo*(1-(VGSQ/VP));
12 rL=RD;
13 AV=-(gm*rL)/(1+gm*RS);
14 disp(AV);
15 AV=-gm*rL;
16 disp(AV);

```

---

Scilab code Exa 22.16 voltage gain and input output resistance

```

1  clc;
2  //e.g 22.16

```

```

3 gm=8000*10**-6;
4 RS=10*10**3;
5 RG=100*10**6;
6 (1/gm);
7 AV=RS/(RS+(1/gm));
8 disp(AV);
9 Ri=RG;
10 Ro=1/gm;
11 disp('ohm',Ro*1,"Ro=");

```

---

Scilab code Exa 22.17 voltage gain and resistance

```

1 clc;
2 //e.g 22.17
3 vin=2*10**-3;
4 gm=5500*10**-6;
5 R1=1*10**6;
6 R2=1*10**6;
7 RS=5000;
8 RL=2000;
9 (1/gm);
10 AV=RS/(RS+(1/gm));
11 disp(AV);
12 Ri=(R1*R2)/(R1+R2);
13 disp('Mohm',Ri*10**-6,"Ri=");
14 Ro=(RS/gm)/(RS+1/gm);
15 disp('ohm',Ro*1,"Ro=");
16 Vo=(RL/(RL+Ro))*(AV*vin);
17 disp('mV',Vo*10**3,"Vo=");

```

---

Scilab code Exa 22.18 voltage gain and input resistance

```

1 clc;

```

```

2 //e.g 22.18
3 gm=2500*10**-6;
4 Ri=2000;
5 RD=10000;
6 AV=gm*RD;
7 disp(AV);
8 Ri1=(Ri/gm)/(Ri+1/gm);
9 disp('ohm',Ri1*1,"Ri1=");

```

---

#### Scilab code Exa 22.19 output resistance

```

1 clc;
2 //e.g 22.19
3 gm=2*10**-3;
4 rd=50*10**3;
5 Rs=1*10**3;
6 Ro=(Rs/gm)/(Rs+1/gm);
7 disp('ohm',Ro*1,"Ro=");

```

---

#### Scilab code Exa 22.20 input resistance and ac voltage gain

```

1 clc;
2 //e.g 22.20
3 gmo=5*10^-3;
4 RD=1*10**3;
5 Rs=200;
6 ID=5*10**-3;
7 Ri1=(Rs/gmo)/(Rs+1/gmo);
8 disp('ohm',Ri1*1,"Ri1=");
9 Vs=ID*Rs;
10 disp('V',Vs*1,"Vs=");
11 VGS=Vs;
12 IDSS=2*ID;

```

```
13 VGSo = (-2 * IDSS) / ID;  
14 gm = gmo * (1 - VGS / -VGSo);  
15 Av = gm * RD;  
16 disp(Av);
```

---

## Chapter 23

# AMPLIFIERS WITH COMPOUND CONFIGURATION

Scilab code Exa 23.1 voltage gain and impedance

```
1  clc ;
2  ID=4*10**-3;
3  IDSS=2*ID;
4  RS=390;
5  VGSQ=-ID*RS;
6  VP=-4.5;
7  RD=2.2*10**3;
8  gm0=(2*IDSS)/(-VP);
9  gm=gm0*(1-(VGSQ/VP));
10 Av1=-gm*RD;
11 Av2=-gm*RD;
12 Av=Av1*Av2;
13 disp(Av);
14 vi=20*10**-3;
15 vo=Av*vi;
16 disp('mV',vo*10**3,"vo=");
17 Zi=10*10**6;
```



```

18 RG=10*10**6;
19 disp('Mohm', Zi*10**-6, "Zi=RG=");
20 Z0=2.2*10**3;
21 RD=2.2*10**3;
22 disp('Kohm', Z0*10**-3, "Z0=RD=");
23 RL=10*10**3;
24 VL=(RL/(Z0+RL))*vo;
25 disp('V', VL*10**3, "VL=");

```

---

### Scilab code Exa 23.3 voltage gain

```

1  clc;
2  VCC=18;
3  R1=7.5*10**3;
4  R2=6.2*10**3;
5  R3=3.9*10**3;
6  RC=1.5*10**3;
7  B1=200;
8  B2=200;
9  RE=1*10**3;
10 CE=100*10**-6;
11 VB1=VCC*(R2+R3)/(R1+R2+R3);
12 disp('V', VB1*1, "VB1=");
13 VB2=VCC*(R3)/(R1+R2+R3);
14 disp('V', VB2*1, "VB2=");
15 IE2=(VB2-0.7)/RE;
16 IC2=IE2;
17 IE1=IC2;
18 IE=IE1;
19 re1=26*10**-3/IE;
20 AV1=-re1/re1;
21 AV2=-RC/re1;
22 AV=AV1*AV2;
23 disp(AV); //ans given in book has -ve sign which is
      wrong

```

---

**Scilab code Exa 23.4 current gain**

```
1 clc ;
2 B1=160;
3 B2=160;
4 BD=B1*B2;
5 disp(BD);
```

---

**Scilab code Exa 23.5 CURRENT GAIN**

```
1 clc ;
2 BD=6000;
3 B1=BD;
4 B2=B1;
5 B=sqrt(BD);
6 disp(B);
```

---

**Scilab code Exa 23.6 VE2 IE2 voltage gain**

```
1 clc ;
2 Vcc=15;
3 RB=2.4*10**6;
4 BD=6000;
5 RE=510;
6 Vi=120*10**-3;
7 VBE=1.6;
8 IB=(Vcc-VBE)/(RB+BD*RE);
9 disp('microA ',IB*10**6," IB=");
10 IE=BD*IB;
```

```
11 disp('mA', IE*10**3, "IE=");
12 IE2=IE
13 VE2=IE2*RE;
14 disp('V', VE2*1, "VE2=");
```

---

#### Scilab code Exa 23.7 zmatrix

```
1 clc;
2 hfe=100;
3 B=100;
4 BD=100**2;
5 RE=1*10**3;
6 hie=1*10**3;
7 ri=10**3;
8 Ri=ri+BD*RE;
9 disp('Mohm', Ri*10**-6, "Ri=");
10 Ro=ri/BD;
11 disp('ohm', Ro*1, "Ro=");
```

---

#### Scilab code Exa 23.8 dc bias currents and voltages

```
1 clc;
2 VCC=16;
3 B1=160;
4 B2=200;
5 RB=1.5*10**6;
6 Vi=120*10**-3;
7 VEB1=0.7;
8 RC=100;
9 IB1=(VCC-VEB1)/(RB+B1*B2*RC);
10 IB2=B1*IB1;
11 IC2=B2*IB2;
12 IE1=IB2;
```

```
13 IC=IE1+IC2;
14 Vodc=VCC-IC*RC;
15 VBE=0.7;
16 Vidc=Vodc-VBE;
17 disp('V',Vidc*1,"Vidc=");
```

---

Scilab code Exa 23.9 load current and output voltage

```
1 clc;
2 VDD=18;
3 RD=2*10**3;
4 IDSS=6*10**-3;
5 VP=-3;
6 ID=IDSS;
7 disp('mA',ID*10**3,"ID=");
8 Vo=VDD-ID*RD;
9 disp('V',Vo*1,"Vo=");
```

---

Scilab code Exa 23.10 calculate the value of constant current

```
1 clc;
2 VEE=-18;
3 R1=4.3*10**3;
4 R2=4.3*10**3;
5 RE=1.8*10**3;
6 B=100;
7 VB=-(-VEE*R2)/(R1+R2);
8 VE=VB-0.7;
9 IE=(VE-(VEE))/RE;
10 disp('mA',IE*10**3,"IE=");
```

---

### Scilab code Exa 23.11 current

```
1 clc ;
2 VZ=5.1;
3 VBE=0.7;
4 RE=1.2*10**3;
5 B=200;
6 I=(VZ-VBE)/RE;
7 disp( 'mA' , I*10**3 , " I=" );
```

---

### Scilab code Exa 23.12 current

```
1 clc ;
2 VCC=18;
3 Rx=2*10**3;
4 VBE=0.7;
5 Ix=(VCC-VBE)/Rx;
6 I=Ix;
7 disp( 'mA' , I*10**3 , " I=" );
```

---

### Scilab code Exa 23.13 value of current

```
1 clc ;
2 VC=5;
3 Re=2*10**3;
4 VCC=6;
5 R=2.2*10**3;
6 VBE=0.7;
7 B=100;
8 I="IO";
9 I=(VCC-2*VBE)/Re;
10 disp( 'mA' , I*10**3 , " I=" );
11 Re=1*10**3;
```

```

12 I=(VCC-2*VBE)/Re;
13 disp('mA',I*10**3,"I=");
14 Re=4*10**3;
15 I=(VCC-2*VBE)/Re;
16 disp('mA',I*10**3,"I=");

```

---

#### Scilab code Exa 23.14 dc voltage and current

```

1 clc;
2 VCC=15;
3 VEE=15;
4 RE=3.9*10**3;
5 RC=4.7*10**3;
6 IE=(VEE-0.7)/RE;
7 disp('mA',IE*10**3,"IE=");
8 IC=IE/2;
9 disp('mA',IC*10**3,"IC=");
10 VC=VCC-IC*RC;
11 disp('V',VC*1,"VC=");

```

---

#### Scilab code Exa 23.15 IC AV V01

```

1 clc;
2 VCC=12;
3 VEE=12;
4 RE=33*10**3;
5 RC1=36*10**3;
6 RC2=36*10**3;
7 B1=150;
8 B2=150;
9 vi1=2*10**-3;
10 IE=(VEE-0.7)/RE;
11 disp('mA',IE*10**3,"IE=");

```

```
12 IC=IE/2;
13 disp('mA',IC*10**3,"IC=");
14 RC=36*10**3;
15 VC=VCC-IC*RC;
16 disp('V',VC*1,"VC=");
17 re1=25*10**-3/IE;
18 Av=RC/(2*re1);
19 disp(Av);
20 vo1=Av*vi1;
21 disp('V',vo1*1,"vo1=");
```

---

Scilab code Exa 23.16 common mode voltage gain

```
1 clc;
2 B=200;
3 ri=20*10**3;
4 RC=47*10**3;
5 RE=43*10**3;
6 Ac=(B*RE)/(ri+2*(B+1)*RE);
7 disp(Ac);
```

---

## Chapter 24

# FREQUENCY RESPONSE OF BJT AND JFET AMPLIFIERS

Scilab code Exa 24.1 power gain

```
1
2 clc;
3 Pi=5;
4 Po=100;
5 G=10*log10(Po/Pi);
6 disp('dB',G*1,"G=");
```

---

Scilab code Exa 24.2 power gain

```
1
2 clc;
3 Pi=5*10**-3;
4 Po=1;
5 G=10*log10(Po/Pi);
6 disp('dB',G*1,"G="); //ans given in the book is wrong
```

---



### Scilab code Exa 24.3 power gain

```
1
2 clc;
3  $P_i=20*10**{-6}$ ;
4  $P_o=100*10**{-6}$ ;
5  $G=10*\log_{10}(P_o/P_i)$ ;
6 disp('dB',G*1,"G=");
```

---

### Scilab code Exa 24.4 power gain

```
1
2 clc;
3  $P_o=25$ ;
4  $G=10*\log_{10}(P_o/(1*10**{-3}))$ ;
5 disp('dB',G*1,"G=");
```

---

### Scilab code Exa 24.5 gain

```
1
2 clc;
3  $V_2=100$ ;
4  $V_1=25$ ;
5  $G=10*\log_{10}(V_2/V_1)$ ;
6 disp('dB',G*1,"G=");
```

---

### Scilab code Exa 24.8 frequency response

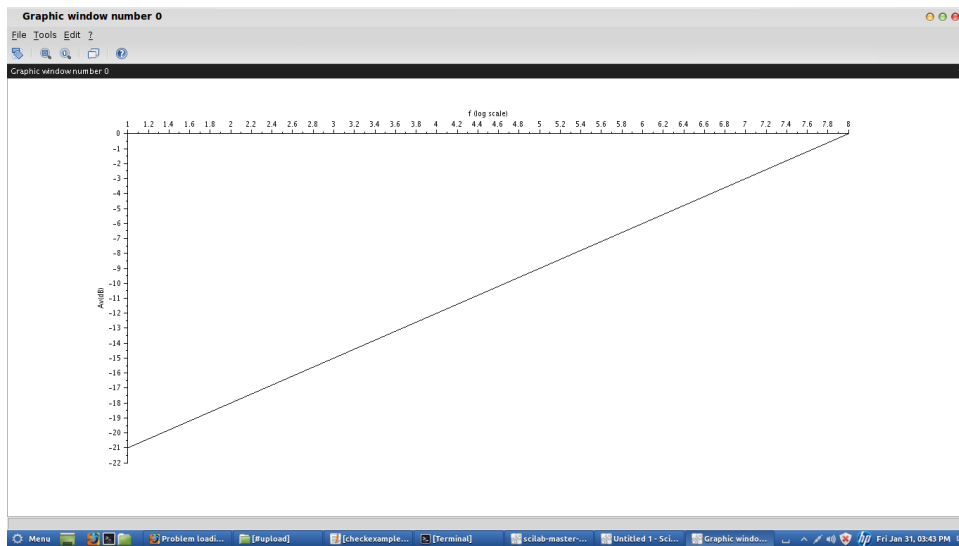


Figure 24.1: frequency response

```

1
2 clc;
3 R=5*10**3;
4 C=0.1*10**-6;
5 f1=1/(2*%pi*R*C);
6 disp('HZ',f1*1," f1=");
7 i=-21:3:0;
8 plot2d(i);
9 a=gca() //get the current axes
10 a.box=" off";
11 a.x_location=" top";
12 xlabel("f (log scale)");
13 ylabel("Av(dB)");

```

---

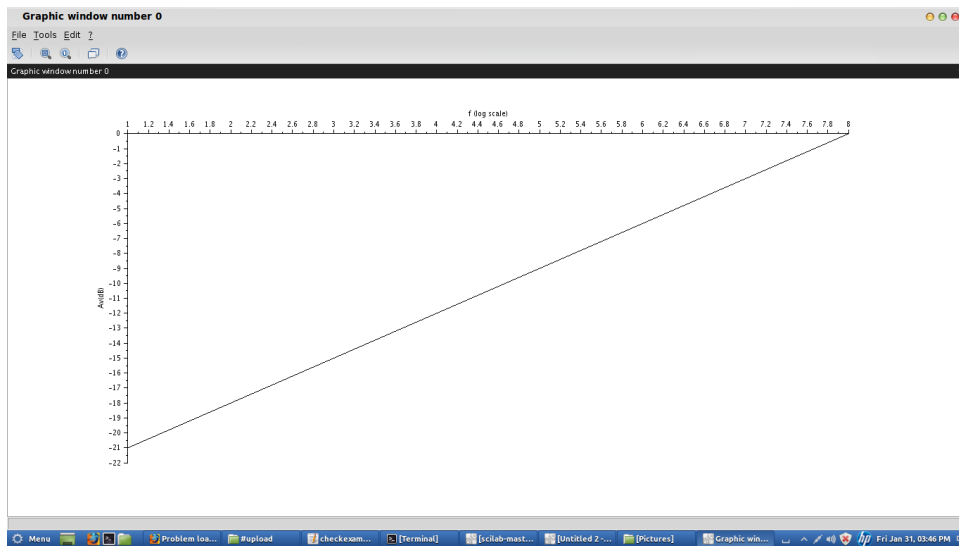


Figure 24.2: FREQUENCY AND PLOT

### Scilab code Exa 24.9 FREQUENCY AND PLOT

```

1
2 clc;
3 RC=4*10**3;
4 R1=40*10**3;
5 R2=10*10**3;
6 RE=2*10**3;
7 RS=1*10**3;
8 RL=2.2*10**3;
9 CS=10*10**-6;
10 CE=20*10**-6;
11 CC=1*10**-6;
12 B=100;
13 VCC=20;
14 VB=(R2*VCC)/(R2+R1);
15 IE=(VB-0.7)/RE;
16 re=(26*10**-3)/IE;
17 B*re;
18 vo=-(RC*RL)/(RC+RL);

```

```

19 Av=vo/re;
20 a=(R1*R2)/(R1+R2);
21 Ri=(a*(B*re))/(a+(B*re));
22 Rs=1*10**3;
23 vibyvs=Ri/(Ri+Rs);
24 Avs=Av*vibyvs;
25 a=(R1*R2)/(R1+R2);
26 Ri=(a*(B*re))/(a+(B*re));
27 fLS=1/(2*pi*(Rs+Ri)*CS);
28 disp('HZ',fLS*1,"fLS=");
29 fLC=1/(2*pi*(RC+RL)*CC);
30 disp('HZ',fLC*1,"fLC=");
31 a=(R1*R2)/(R1+R2);
32 RS=(a*RS)/(a+RS);
33 b=(RS/B+re);
34 Re=(RE*b)/(RE+b);
35 fLE=1/(2*pi*Re*CE);
36 disp('HZ',fLE*1,"fLE=");
37 i=-21:3:0;
38 plot2d(i);
39 a=gca() //get the current axes
40 a.box="off";
41 a.x_location="top";
42 xlabel("f (log scale)");
43 ylabel("Av(dB)");

```

---

## Chapter 25

# LARGE SIGNAL OR POWER AMPLIFIERS

Scilab code Exa 25.1 collector current and Vce

```
1  clc;
2  VCC=10;
3  R1=10*10**3;
4  R2=5*10**3;
5  RC=1*10**3;
6  RE=500;
7  RL=1.5*10**3;
8  B=100;
9  VBE=0.7;
10 VR2=VCC*(R2/(R1+R2));
11 IEQ=(VR2-VBE)/RE;
12 ICQ=IEQ;
13 VCEQ=VCC-ICQ*(RC+RE);
14 rL=(RC*RL)/(RC+RL);
15 ICsat=ICQ+(VCEQ/rL);
16 disp('mA', ICsat*10**3, " ICsat=");
17 VCEsat=0;
18 disp(VCEsat);
19 ICcutoff=0;
```

```
20 disp(ICcutoff);
21 VCEcutoff=VCEQ+ICQ*rL;
22 disp('V',VCEcutoff,"VCEcutoff=");
```

---

### Scilab code Exa 25.2 COMPLIANCE

```
1 clc;
2 VCC=20;
3 R1=10*10**3;
4 R2=1.8*10**3;
5 RC=620;
6 RE=200;
7 RL=1.2*10**3;
8 hfe=180;
9 VB=VCC*(R2/(R1+R2));
10 VBE=0.7;
11 VE=VB-VBE;
12 IE=VE/RE;
13 IC=IE;
14 VCE=VCC-IE*(RC+RE);
15 ICQ=IC;
16 VCEQ=VCE;
17 rL=(RC*RL)/(RC+RL);
18 PP=2*ICQ*rL;
19 disp('V',PP,"PP=");
20 PP=2*VCEQ;
21 disp('V',PP,"PP=");
```

---

### Scilab code Exa 25.3 voltage gain and power gain

```
1 clc;
2 re=8;
3 RC=220;
```

```
4 RE=47;
5 R1=4.7*10**3;
6 R2=470;
7 B=50;
8 rL=RC;
9 AV=rL/re;
10 Ai=B;
11 Ap=AV*Ai;
12 disp(Ap);
```

---

**Scilab code Exa 25.4** collector efficiency and power rating of transistor

```
1 clc;
2 Ptrdc=20;
3 Poac=5;
4 ne=(Poac/Ptrdc);
5 disp('%',ne*100,"ne=");
6 "power rating of transistor=20W";
```

---

**Scilab code Exa 25.5** ac power

```
1
2 clc;
3 pcdc=10;
4 nc=0.32;
5 poac=pcdc*nc/(1-nc);
6 disp('W',poac," poac=");
```

---

**Scilab code Exa 25.6** power dissipated

```

1  clc;
2  nc=0.5;
3  VCC=24;
4  Poac=3.5;
5  Ptrdc=Poac/nc;
6  disp('W',Ptrdc,"Ptrdc=");
7  Pcdc=Ptrdc-Poac;
8  disp('W',Pcdc,"Pcdc=");

```

---

### Scilab code Exa 25.7 power and efficiency

```

1  clc;
2  VCC=20;
3  VCEQ=10;
4  ICQ=600*10**-3;
5  RL=16;
6  IP=300*10**-3;
7  Pindc=VCC*ICQ;
8  disp('W',Pindc,"Pindc=");
9  PRLdc=ICQ**2*RL;
10 disp('W',PRLdc,"PRLdc=");
11 I=IP/sqrt(2);
12 Poac=I**2*RL;
13 disp('W',Poac,"Poac=");
14 Ptrdc=Pindc-PRLdc;
15 disp('W',Ptrdc,"Ptrdc=");
16 Pcdc=Ptrdc-Poac;
17 disp('W',Pcdc,"Pcdc=");
18 no=Poac/Pindc;
19 disp('%',no*100,"no=");
20 no=Poac/Ptrdc;
21 disp('%',no*100,"no=");

```

---



### Scilab code Exa 25.8 resistance

```
1 clc;  
2 a=15;  
3 RL=8;  
4 RL1=a**2*RL;  
5 disp('Kohm',RL1*10**-3,'RL1=');
```

---

### Scilab code Exa 25.9 turns ratio

```
1 clc;  
2 RL=16;  
3 RL1=10*10**3;  
4 a=sqrt(RL1/RL);  
5 disp(a);
```

---

### Scilab code Exa 25.10 max power

```
1 clc;  
2 RL=8;  
3 a=10;  
4 ICQ=500*10**-3;  
5 RL=a**2*RL;  
6 Poac=(1/2)*ICQ**2*RL;  
7 disp('W',Poac,'Poac=');
```

---

### Scilab code Exa 25.11 ac output power ICQ turns ratio

```
1 clc;  
2 Ptrdc=100*10**-3;
```

```

3 VCC=10;
4 RL=16;
5 no=0.5;
6 Poac=no*Ptrdc;
7 disp('mW',Poac*10**3,"Poac=");
8 ICQ=2*Poac/VCC;
9 disp('A',ICQ,"ICQ=");
10 RL1=VCC/ICQ;
11 a=sqrt(RL1/RL);
12 disp(a);

```

---

#### Scilab code Exa 25.12 power

```

1 clc;
2 VCC=10;
3 IP=50*10**-3;
4 RL=4;
5 I=IP/sqrt(2);
6 Poac=I^2*RL;
7 disp('mW',Poac*10**3,"Poac=");
8 ICQ=IP;
9 RL1=VCC/ICQ;
10 a=sqrt(RL1/RL);
11 disp(a);
12 V1=VCC;
13 V2=V1/a;
14 I2p=V2/RL;
15 I2=I2p/sqrt(2);
16 P=(I2^2)*RL;
17 disp('mW',P*10**3,"P=");

```

---

#### Scilab code Exa 25.13 power

```
1 clc;
2 RL=8;
3 VP=16;
4 P=(VP^2)/(2*RL);
5 disp('W',P,'P=');
```

---

#### Scilab code Exa 25.14 PinDC PoAC

```
1 clc;
2 no=0.6;
3 Pcdc=2.5;
4 //Poac=PinDC*no;
5 //PinDC=2*Pcdc+Poac;
6 PinDC=(2*Pcdc)/(1-no);
7 disp('W',PinDC,'PinDC=');
8 Poac=0.6*PinDC;
9 disp('W',Poac,'Poac=');
```

---

# Chapter 26

## TUNED AMPLIFIERS

Scilab code Exa 26.1 frequency

```
1 clc;
2 //e.g 26.1
3 L=150*10**-6;
4 C=100*10**-12;
5 fo=0.159/sqrt(L*C);
6 disp('MHZ',fo*10**-6,"fo");
```

---

Scilab code Exa 26.2 frequency and impedance

```
1 clc;
2 //e.g 26.2
3 L=100*10**-6;
4 C=100*10**-12;
5 R=5;
6 fo=0.159/sqrt(L*C);
7 disp('MHZ',fo*10**-6,"fo=");
8 Zp=L/(C*R);
9 disp('Kohm',Zp*10**-3,"Zp=");
```

---

### Scilab code Exa 26.3 bandwidth

```
1 clc;  
2 //e.g 26.3  
3 fo=1*10**6;  
4 Qo=100;  
5 BW=fo/Qo;  
6 disp('kHz',BW*10**-3,"BW=");
```

---

### Scilab code Exa 26.4 Q factor

```
1 clc;  
2 //e.g 26.4  
3 fo=1600*10**3;  
4 BW=10*10**3;  
5 Qo=fo/BW;  
6 disp(Qo);
```

---

### Scilab code Exa 26.5 Q factor

```
1 clc;  
2 //e.g 26.5  
3 fo=2*10**6;  
4 BW=50*10**3;  
5 Qo=fo/BW;  
6 disp(Qo);
```

---

### Scilab code Exa 26.6 impedance

```
1  clc ;
2  //e.g 26.6
3  fo=455*10**3;
4  BW=10*10**3;
5  XL=1255;
6  Qo=fo/BW;
7  R=XL/Qo;
8  L=XL/(2*%pi*fo);
9  C=1/(XL*2*%pi*fo);
10 Zp=L/(C*R);
11 disp( 'Kohm ', Zp*10**-3, "Zp=" );
```

---

# Chapter 27

## FEEDBACK AMPLIFIERS

Scilab code Exa 27.1 voltage gain

```
1 clc;  
2 //e.g 27.1  
3 AV=400;  
4 beta=0.1;  
5 AV1=AV/(1+beta*AV);  
6 disp(AV1);
```

---

Scilab code Exa 27.2 fraction of output

```
1 clc;  
2 //e.g 27.2  
3 AV=1000;  
4 AV1=10;  
5 beta=((AV/AV1)-1)/AV;  
6 disp(beta);
```

---

### Scilab code Exa 27.3 feedback

```
1 clc;  
2 //e.g 27.3  
3 AV=100;  
4 AV1=20;  
5 beta=((AV/AV1)-1)/AV;  
6 disp(beta);
```

---

### Scilab code Exa 27.4 voltage gain and beta

```
1 clc;  
2 //e.g 27.4  
3 Vo=12.5;  
4 Vin1=1.5;  
5 Vin=0.25;  
6 AV=Vo/Vin;  
7 disp(AV);  
8 AV1=Vo/Vin1;  
9 beta=((AV/AV1)-1)/AV;  
10 disp(beta);
```

---

### Scilab code Exa 27.5 beta

```
1 clc;  
2 //e.g 27.5  
3 AV=60;  
4 AV1=80;  
5 //80=AV/(1-BETA*AV)  
6 beta=((AV1/AV)-1)/AV1;  
7 disp(beta,"beta=");  
8 beta=1/AV;  
9 disp(beta,"beta=");
```



---

**Scilab code Exa 27.6 beta**

```
1 clc;
2 //e.g 27.6
3 AV1=100;
4 Vin=50*10**-3;
5 Vin1=0.6;
6 Vo=AV1*Vin1;
7 Av=Vo/Vin;
8 disp(Av);
9 beta=((Av/AV1)-1)/Av;
10 disp(' *10^-3 ',beta*10**3," beta=");
```

---

**Scilab code Exa 27.7 change in closed loop gain**

```
1
2 clc;
3 Av=800;
4 B=0.05;
5 dAvbyAv=20;
6 a=dAvbyAv*(1/(1+B*Av));
7 disp('%',a*1," a=");
```

---

**Scilab code Exa 27.8 values of AV and beta**

```
1 clc;
2 AV1=100;
3 A=0.01;
4 B=0.2;
```

```
5 C=B/A;
6 AV=AV1*C;
7 beta=C/AV;
8 disp(beta,"beta=");
```

---

#### Scilab code Exa 27.9 gain and beta

```
1 clc;
2 //e.g 27.9
3 AV=100;
4 BW=200*10**3;
5 beta=0.05;
6 BW1=(1+beta*AV)*BW;
7 disp('KHZ',BW1*10^-3,"BW1=");
8 AV1=AV/(1+beta*AV);
9 disp(AV1);
10 //1*10**6=(1+beta1*AV)*BW;
11 beta1=((1*10**6)/(200*10**3))-1)/100;
12 disp(beta1);
```

---

#### Scilab code Exa 27.10 bw

```
1 clc;
2 //e.g 27.10
3 AV=1500;
4 BW=4*10**6;
5 AV1=150;
6 beta=((1500/150)-1)/1500;
7 disp(beta);
8 BW1=(1+beta*AV)*BW;
9 disp('MHZ',BW1*10**-6,"BW1=");
```

---

### Scilab code Exa 27.11 frequency

```
1  clc;
2  //e.g 27.11
3  Rin=4.2*10**3;
4  AV=220;
5  beta=0.01;
6  Ri=(1+beta*AV)*Rin;
7  disp('Kohm',Ri*10**-3,'Ri=');
8  F1=1.5*10**3;
9  FC1=F1/(1+beta*AV);
10 disp('HZ',FC1,'FC1=');
11 F2=501.5*10**3;
12 FC2=(1+beta*AV)*F2;
13 disp('KHZ',FC2*10**-3,'FC2=');
```

---

### Scilab code Exa 27.12 gain and distortion gain

```
1  clc;
2  //e.g 27.12
3  AV=1000;
4  f1=50;
5  f2=200*10**3;
6  D=0.05;
7  beta=0.01;
8  AV1=AV/(1+beta*AV);
9  disp(AV1);
10 fl1=f1/(1+beta*AV);
11 disp('HZ',fl1,'fl1=');
12 fu2=(1+beta*AV)*f2;
13 disp('MHZ',fu2*10**-6,'fu2=');
14 D1=D/(1+beta*AV);
```

```
15 disp( '%', D1*100, "D1=" );
```

---

Scilab code Exa 27.13 beta and gain

```
1 clc;
2 //e.g 27.13
3 AV=100;
4 RDN=0.8;
5 //0.8=1-(1/(1+beta*AV));
6 beta=((1/0.2)-1)/100;
7 disp(beta);
8 AV1=AV/(1+beta*AV);
9 disp(AV1);
```

---

Scilab code Exa 27.14 voltage gain and resistance

```
1 clc;
2 //e.g 27.14
3 AV=300;
4 Ri=1.5*10**3;
5 R0=50*10**3;
6 b=1/15;
7 AV1=AV/(1+b*AV);
8 disp(AV1);
9 Ri1=(1+b*AV)*Ri; //input resistance
10 disp('Kohm', Ri1*10**-3, "Ri1=");
11 Ri1=R0/(1+b*AV); //output resistance
12 disp('kohm', Ri1*10**-3, "Ri1=");
```

---

Scilab code Exa 27.15 voltage gain and resistance

```

1  clc;
2  //e.g 27.15
3  hfe=100;
4  hie=2*10**3;
5  Rc=470;
6  Re1=100;
7  Re2=100;
8  R1=15000;
9  R2=5600;
10 AV=(hfe*Rc)/hie;
11 disp(AV);
12 a=((R1*R2)/(R1+R2));
13 Ri=(a*hie)/(a+hie);
14 disp('ohm',Ri*1," Ri=");
15 b=Re1/Rc;
16 AV1=AV/(1+b*AV);
17 disp(AV1);
18 Ri1=Ri*(1+b*AV);
19 disp('OHM',Ri1*1," Ri1=");

```

---

#### Scilab code Exa 27.16 gain and resistance

```

1  clc;
2  //e.g 27.16
3  hfe=99;
4  hie=2*10**3;
5  hie1=2000;
6  hie2=2000;
7  Rc=22*10**3;
8  R4=100;
9  R1=220*10**3;
10 R2=22*10**3;
11 RC1=4.7*10**3;
12 R3=7.8*10**3;
13 Ri=hie;

```

```

14 a=(R1*R2)/(R1+R2);
15 b=(a*Rc)/(a+Rc);
16 R01=(b*hie1)/(b+hie1)
17 disp('Kohm',R01*10**-3,"R01=");
18 Ri2=hie;
19 C=(R3+R4);
20 R02=(RC1*C)/(RC1+C)
21 disp('Kohm',R02*10**-3,"R02=");
22 AV1=hfe*R01/hie;
23 AV2=hfe*R02/hie;
24 AV=AV1*AV2;
25 bta=R4/(R3+R4);
26 Ri1=Ri*(1+bta*AV);
27 disp('Kohm',Ri1*10**-3,"Ri1=");
28 R02=R02/(1+bta*AV);
29 disp('ohm',R02*1,"R02=");
30 AV1=AV/(1+bta*AV);
31 disp(AV1);

```

---

# Chapter 28

## SINUSOIDAL OSCILLATORS

Scilab code Exa 28.1 inductance

```
1 clc;  
2 //e.g 28.1  
3 fo=22*10**3;;  
4 C=2*10**-9;  
5 L=((0.159/fo)^2)/C;  
6 disp('H',L*1,"L=");
```

---

Scilab code Exa 28.2 frequency

```
1 clc;  
2 //e.g 28.2  
3 fo=2.2*10**6;  
4 //fo1=(sqrt(2))/sqrt(C);  
5 fo1=sqrt(2)*fo;  
6 disp('MHZ',fo1*10**-6,"fo1=");
```

---

### Scilab code Exa 28.3 frequency

```
1 clc;  
2 //e.g 28.3  
3 C=100*10**-12;  
4 L1=30*10**-6;  
5 L2=1*10**-8;  
6 fo=1/(2*%pi*sqrt((L1+L2)*C));  
7 disp('MHZ',fo*10**-6," fo=");
```

---

### Scilab code Exa 28.4 frequency

```
1 clc;  
2 //e.g 28.4  
3 L1=1000*10**-6;  
4 L2=100*10**-6;  
5 M=20*10**-6;  
6 C=20*10**-12;  
7 fo=1/(2*%pi*sqrt((L1+L2+2*M)*C));  
8 disp('MHZ',fo*10**-6," fo=");
```

---

### Scilab code Exa 28.5 frequency

```
1 clc;  
2 //e.g 28.5  
3 C=1*10**-9;  
4 L1=4.7*10**-3;  
5 L2=47*10**-6;  
6 fo=1/(2*%pi*sqrt((L1+L2)*C));  
7 disp('KHZ',fo*10**-3," fo=");
```

---



### Scilab code Exa 28.6 capacitance

```
1 clc;
2 //e.g 28.6
3 L1=2*10**-3;
4 L2=20*10**-6;
5 fo=950*10**3;
6 C=1/(4*%pi^2*(L1+L2)*fo^2);
7 disp('pF',C*10**12,"C=");
8 fo=2050*10**3;
9 C=1/(4*%pi^2*(L1+L2)*fo^2);
10 disp('pF',C*10**12,"C=");
```

---

### Scilab code Exa 28.7 capacitance

```
1 clc;
2 //e.g 28.7
3 L1=0.1*10**-3;
4 L2=10*10**-6;
5 fo=4110*10**3;
6 M=20*10**-6;
7 C=1/(4*%pi^2*(L1+L2+M)*fo^2);
8 disp('pF',C*10**12,"C=");
9 AV=(L1/L2);
10 disp(AV);
```

---

### Scilab code Exa 28.8 c1 and c2

```
1 clc;
2 //e.g 28.8
3 fo=100*10**3;
4 L=0.5*10**-3;
5 C=2/(4*%pi^2*L*fo^2);
```

```
6 disp('microF',C*10**6,"C=");
```

---

#### Scilab code Exa 28.9 gain and frequency

```
1 clc;
2 //e.g 28.9
3 C1=0.001*10**-6;
4 C2=0.01*10**-6;
5 L=5*10**-6;
6 AV=C2/C1;
7 disp(AV);
8 C=(C1*C2)/(C1+C2)
9 fo=1/(2*pi*sqrt(L*C));
10 disp('MHZ',fo*10**-6,"fo=");
```

---

#### Scilab code Exa 28.10 frequency

```
1 clc;
2 //e.g 28.10
3 C1=0.1*10**-6;
4 C2=1*10**-6;
5 L=470*10**-6;
6 C=(C1*C2)/(C1+C2)
7 fo=1/(2*pi*sqrt(L*C));
8 disp('kHz',fo*10**-3,"fo=");
```

---

#### Scilab code Exa 28.11 inductance and frequency

```
1 clc;
2 //e.g 28.11
```

```

3 C1=100*10**-12;
4 C2=7500*10**-12;
5 f01=950*10**3;
6 f02=2050*10**3;
7 C=(C1*C2)/(C1+C2);
8 //f01=1/(2*%pi*sqrt(L*C))
9 L1=1/(4*(%pi)^2*C*f01^2);
10 disp('microH',L1*10**6,'L1=');
11 L2=1/(4*(%pi)^2*C*f02^2);
12 disp('microH',L2*10**6,'L2=');

```

---

#### Scilab code Exa 28.13 frequency

```

1 clc;
2 //e.g 28.13
3 C1=0.1*10**-6;
4 C2=1*10**-6;
5 C3=100*10**-12;
6 L=470*10**-6;
7 C=1/((1/C1)+(1/C2)+(1/C3));
8 fo=1/(2*%pi*sqrt(L*C));
9 disp('kHz',fo*10**-3,'fo=');

```

---

#### Scilab code Exa 28.14 frequency

```

1 clc;
2 //e.g 28.14
3 L=0.33;
4 C1=0.065*10**-12;
5 C2=1*10**-12;
6 R=5.5*10**3;
7 fs=1/(2*%pi*sqrt(L*C1));
8 disp('MHZ',fs*10**-6,'fs=');

```

```
9 Q=(2*%pi*fs*L)/R;  
10 disp(Q);
```

---

Scilab code Exa 28.15 frequency fs and fp

```
1 clc; //e.g 28.14  
2 L=0.8;  
3 C1=0.08*10**-12;  
4 C2=1*10**-12;  
5 R=5*10**3;  
6 fs=1/(2*%pi*sqrt(L*C1));  
7 disp('MHZ',fs*10**-6," fs=");  
8 C=(C1*C2)/(C1+C2);  
9 fp=1/(2*%pi*sqrt(L*C));  
10 disp('MHZ',fp*10**-6," fp=");
```

---

# Chapter 29

## NON SINUSOIDAL OSCILLATORS

Scilab code Exa 29.1 FREQUENCY

```
1 clc;  
2 //e.g 29.1  
3 R=20*10**3;  
4 C=100*10**-12;  
5 f=1/(1.38*R*C);  
6 disp('kHz',f*10**-3," f=");
```

---

Scilab code Exa 29.2 value of capacitors

```
1 clc;  
2 //e.g 29.2  
3 R1=2*10**3;  
4 R2=20*10**3;  
5 C1=0.01*10**-6;  
6 C2=0.05*10**-6;  
7 T=0.69*(R1*C1+R2*C2)
```

```
8 disp('ms',T*10**3,"T=");
9 f=1/T;
10 disp('kHz',f*10**-3,"f=");
```

---

### Scilab code Exa 29.3 value of capacitors

```
1
2 clc;
3 T1=1*10**-6;
4 f=100*10**3;
5 R1=10*10**3;
6 R2=10*10**3;
7 T=1/f;
8 C1=T1/(0.69*R1);
9 disp('pF',C1*10**12,"C1=");
10 T2=T-T1;
11 C2=T2/(0.69*R1);
12 disp('pF',C2*10**12,"C2=");
```

---

### Scilab code Exa 29.4 value of circuit components

```
1
2 clc;
3 T2A=310*10**-6;
4 T2B=250*10**-6;
5 VCC=15;
6 IC=5*10**-3;
7 hFC=20;
8 RC=VCC/IC;
9 RC1=RC;
10 RC2=RC;
11 disp('ohm',RC*1,"RC1=RC2=RC=");
12 hFE=hFC;
```

```

13 IBsat=IC/hFE;
14 IB=2*IBsat;
15 R=VCC/IB;
16 R1=R;
17 R2=R;
18 C1=T2A/(0.69*R1);
19 disp('pF',C1*10**12,"C1=");
20 C2=T2B/(0.69*R2);
21 disp('pF',C2*10**12,"C2=");
22 tao1=R1*C1;
23 disp('microsec',tao1*10**6,"tao1=");
24 tao2=R2*C2;
25 disp('microsec',tao2*10**6,"tao2=");
26 tao11=RC1*C1/2;
27 disp('microsec',tao11*10**6,"tao11=");
28 tao12=RC2*C2/2;
29 disp('microsec',tao12*10**6,"tao12=");

```

---

#### Scilab code Exa 29.5 duty cycle

```

1
2 clc;
3 f=20*10**3;
4 T=1/f;
5 disp('microsec',T*10**6,"T=");
6 t=(0:0.1:5*%pi)';
7 plot2d1('onn',t,[squarewave(t,75)]);

```

---

#### Scilab code Exa 29.6 R3 and C1

```

1
2 clc;
3 close;

```

```

4 f=100*10(-3);
5 T=(1/f);
6 disp('us',T*1,'T=');
7 tp=(1/T);
8 disp('us',tp*1,'tp=');
9 C1=0.001*10(-6);
10 R3=((5*10(-6))/(0.69*C1));
11 disp('kohm',R3*10(-3), 'R3=');

```

---

#### Scilab code Exa 29.7 width

```

1
2 clc;
3 RC=2*10**3;
4 R3=20*10**3;
5 rbb=200;
6 C1=1000*10**-12;
7 T=0.69*C1*R3;
8 disp('microsec',T*10**6,"T=");

```

---

#### Scilab code Exa 29.8 value of pulse width

```

1 clc;
2 //e.g 29.8
3 R1=2.2*10**3;
4 C1=0.01*10**-6;
5 tp=1.1*R1*C1;
6 disp('microS',tp*10**6,"tp=");

```

---

#### Scilab code Exa 29.9 CIRCUIT



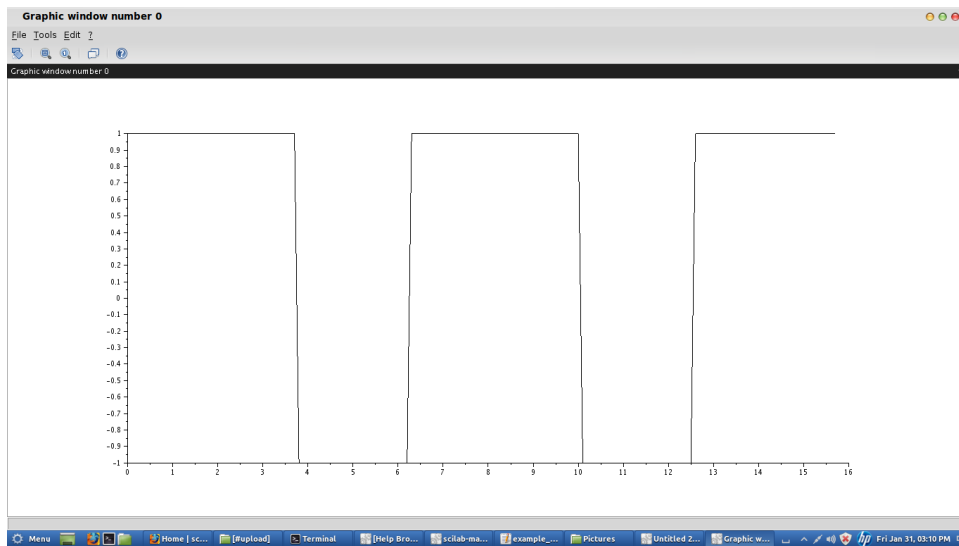


Figure 29.1: CIRCUIT

```

1
2 clc;
3 tp=10*10**-6;
4 c=1000*10**-12;
5 R1=tp/(1.1*c);
6 disp('Kohm',R1*10**-3,"R1=");
7 t=(0:0.1:5*%pi)';
8 plot2d1('onn',t,[squarewave(t,60)]);

```

---

#### Scilab code Exa 29.10 duty cycle

```

1 clc;
2 //e.g 29.10
3 R1=6.8*10**3;
4 R2=4.7*10**3;
5 C1=1000*10**-12;

```

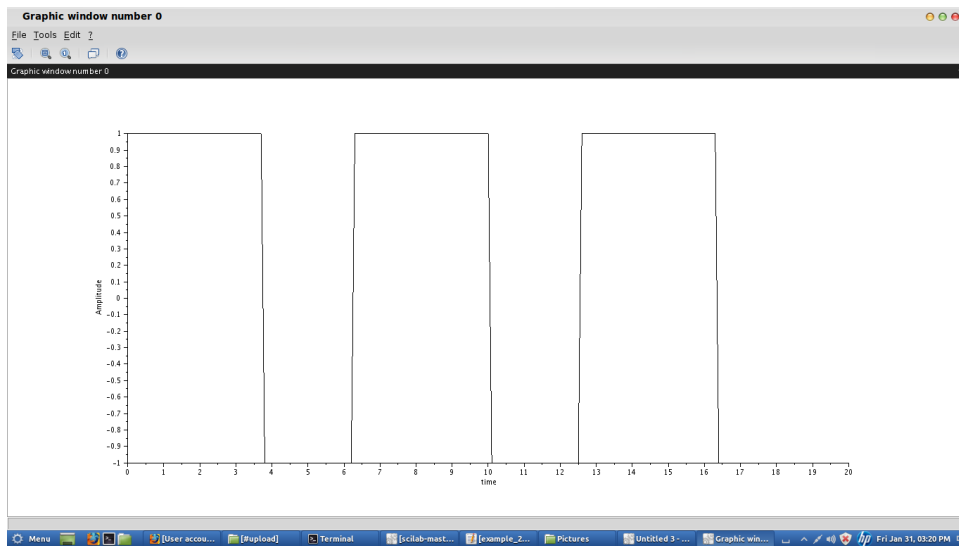


Figure 29.2: frequency and graph

```

6 t2=0.7*R2*C1;
7 disp('microS ',t2*10**6," t2=");
8 t1=0.7*(R1+R2)*C1;
9 disp('microS ',t1*10**6," t1=");
10 dc=(t1/(t1+t2))*100;
11 disp('%',dc*1," dc=");

```

---

### Scilab code Exa 29.11 frequency and graph

```

1
2 clc;
3 R1=27*10**3;
4 R2=56*10**3;
5 C1=0.01*10**-6;
6 t2=0.7*R2*C1;
7 t1=0.7*(R1+R2)*C1;

```

```
8 T=t1+t2;
9 f=1/T;
10 disp('kHz',f*10**-3,"f=");
11 t=(0:0.1:6*%pi)';
12 plot2d1('onn',t,[squarewave(t,60)]);
```

---

### Scilab code Exa 29.12 design

```
1
2 clc;
3 f=50*10**3;
4 dutyc=0.60;
5 C=0.0022*10**-6;
6 T=1/f;
7 t1=dutyC*T;
8 t2=T-t1;
9 R2=(t2)/(0.7*C);
10 disp('Kohm',R2*10**-3,"R2=");
11 R1=(t1)/(0.7*C)-R2;
12 disp('Kohm',R1*10**-3,"R1=");
```

---

# Chapter 30

## LINEAR WAVE SHAPING CIRCUIT

Scilab code Exa 30.2 VOLTAGE

```
1
2 clc;
3 C=1*10**-6;
4 Vi=6;
5 R=10*10**3;
6 Vo=-3;
7 t=8*10**-3;
8 tao=R*C;
9 disp('msec',tao*10**3,"tao=");
10 vf=6*(1-exp(-8/10));
11 disp('V',vf*1,"vf=");
12 output=vf-3.0;
13 disp('V',output*1,"output=");
```

---

Scilab code Exa 30.3 VOLTAGE

```
1
2 clc;
3 t=0.1;
4 tao=0.2;
5 vc=0.5*exp(-t/tao);
6 disp('V',vc*1,"vc=");
```

---

Scilab code Exa 30.4 peak value of input voltage

```
1
2 clc;
3 tao=250*10**-12;
4 v=50;
5 a=v/tao;
6 t=0.05*10**-6;
7 vp=a*t;
8 disp('kV',vp*10**-3,"vp=");
```

---

# Chapter 31

## TIME BASE CIRCUIT

Scilab code Exa 31.1 frequency

```
1 clc;
2 //e.g 31.1
3 R=100*10**3;
4 C=0.4*10**-6;
5 n=0.57;
6 f=1/(2.3*R*C*log10(1/(1-n)));
7 disp('HZ',f*1,"f=");
```

---

Scilab code Exa 31.2 period and frequency of oscillation and R

```
1 clc;
2 //e.g 31.2
3 n=0.62;
4 R=5*10**3;
5 C=0.05*10**-6;
6 T=2.3*R*C*log10(1/(1-n))
7 disp('msec',T*10**3,"T=");
8 f=1/T;
```

```
9 disp('HZ',f*1,"f=");
10 f1=50;
11 T1=1/f1;
12 R=T1/(2.3*C*log10(1/(1-n)));
13 disp('kohm',R*10**-3,"R=");
14 C=0.5*10**-6;
15 R=T1/(2.3*C*log10(1/(1-n)));
16 disp('kohm',R*10**-3,"R=");
```

---

# Chapter 32

## OPERATIONAL AMPLIFIERS

Scilab code Exa 32.1 CMRR

```
1 clc;  
2 Adm=200000;  
3 Acn=6.33;  
4 CMRR=20*log10(Adm/Acn);  
5 disp('dB', CMRR*1, "CMRR=");
```

---

Scilab code Exa 32.2 common mode gain

```
1 clc;  
2 Adm=30000;  
3 //CMRR=20*log10(Adm/Acn);  
4 a=90/20;  
5 Acn=(Adm/10^a);  
6 disp(Acn);
```

---



### Scilab code Exa 32.3 maximum frequency

```
1 clc;  
2 //e.g 32.3  
3 SR=0.5*10**6;  
4 Vpk=0.1;  
5 fmax=SR/(2*%pi*Vpk);  
6 disp('kHz',fmax*10**-3,"fmax=");
```

---

### Scilab code Exa 32.4 suitable opamps

```
1 clc;  
2 Vpk=10;  
3 slewrate=0.5*10**6;  
4 fmax=slewrate/(2*%pi*Vpk);  
5 disp('HZ',fmax*1,"fmax="); //value of microamp 741  
6 slewrate=13*10**6;  
7 fmax=slewrate/(2*%pi*Vpk);  
8 disp('kHz',fmax*10**-3,"fmax="); //TLO 81  
9 //value of microamp 741 is much lower than that of  
   the input signal.And value of TLO81 is much  
   higher than input signal,therefore TLO81 can be  
   used
```

---

### Scilab code Exa 32.5 value of vin

```
1 clc;  
2 //e.g 32.5  
3 ACL=200;  
4 Vout=8;  
5 Vin=Vout/ACL;  
6 disp('mV',Vin*10**3,"Vin=");
```

---

### Scilab code Exa 32.7 voltage

```
1 clc;  
2 //e.g 32.7  
3 R1=1*10**3;  
4 R2=10*10**3;  
5 ACL=R2/R1  
6 disp(" Voltage at node A increases from 1V to 4v");
```

---

### Scilab code Exa 32.8 output voltage

```
1 clc;  
2 R1=1*10**3;  
3 R2=2*10**3;  
4 Vi=1;  
5 Acl=R2/R1;  
6 V0=Acl*Vi;  
7 disp('V',V0*1," V0=");
```

---

### Scilab code Exa 32.9 gain input impedance cmrr and fmax

```
1 clc;  
2 AcM=0.001;  
3 Aol=180000;  
4 Zin=1*10**6;  
5 Zout=80;  
6 SR=0.5;  
7 R2=100*10**3;  
8 R1=10*10**3;
```

```

9  Acl=R2/R1;
10 disp(Acl);
11 Zin=R1;
12 disp('kOhm',Zin*10**-3,"Zin=");
13 disp('Ohm',Zout*1,"Zout=");
14 CMRR=Acl/Acm;
15 disp(CMRR);
16 Vpk=5;
17 fmax=SR/(2*%pi*Vpk);
18 disp('kHz',fmax*10**3,"fmax=");

```

---

Scilab code Exa 32.10 Acl CMRR and maximum operating frequency

```

1  clc;
2  R2=100*10**3;
3  R1=10*10**3;
4  Acl=1+(R2/R1);
5  Acm=0.001;
6  disp(Acl);
7  CMRR=Acl/Acm;
8  disp(CMRR);
9  SR=0.5;
10 Vpk=5.5;
11 fmax=SR/(2*%pi*Vpk);
12 disp('kHz',fmax*10**3,"fmax=");

```

---

Scilab code Exa 32.11 Acl CMRR and maximum operating frequency

```

1  clc;
2  Acm=0.001;
3  AOL=180000;
4  Zin=1*10**6;
5  Zout=80;

```

```

6 SR=0.5;
7 Ac1=1;
8 CMRR=Ac1/Acm;
9 disp(CMRR);
10 Vpk=3;
11 fmax=SR/(2*%pi*Vpk)
12 disp('kHz',fmax*10**3,"fmax=");

```

---

### Scilab code Exa 32.12 output voltage

```

1 clc;
2 //e.g 32.12
3 V1= 0.1;
4 V2=1;
5 V3=0.5;
6 R1=10*10**3;
7 R2=10*10**3;
8 R3=10*10**3;
9 R4=22*10**3;
10 Vout=((-R4*V1)/R1)+((-R4*V2)/R2)+((-R4*V3)/R3);
11 disp('V',Vout*-1,"Vout=");

```

---

### Scilab code Exa 32.14 output voltage

```

1 clc;
2 V1=-2;
3 V2=2;
4 V3=-1;
5 R1=200*10**3;
6 R2=250*10**3;
7 R3=500*10**3;
8 Rf=1*10**6;
9 Vout=(-Rf/R1)*V1+(-Rf/R2)*V2+(-Rf/R3)*V3;

```

```
10 disp('V',Vout*1,"Vout=");
```

---

# Chapter 33

## OP AMP APPLICATION

Scilab code Exa 33.1 value of capacitance

```
1 clc;
2 R1=1*10**3;
3 R2=100*10**3;
4 Rf=R2;
5 f1=159;
6 C=1/(2*%pi*R2*f1);
7 disp('microF',C*1,"C=");
```

---

Scilab code Exa 33.2 frequency

```
1 clc;
2 R1=1*10**3;
3 Rf=51*10**3;
4 Cf=0.1*10**-6;
5 f=1/(2*%pi*Rf*Cf);
6 disp('HZ',f*1,"f="); //ans given in book is wrong
7 fmin=10*f;
8 disp('HZ',fmin*1,"fmin=");
```

---

**Scilab code Exa 33.3** cutoff frequency and max operating frequency

```
1 clc;  
2 R1=10*10**3;  
3 Cf=0.01*10**-6;  
4 f=1/(2*%pi*R1*Cf);  
5 disp('HZ',f*1,"f=");//ans given in book is wrong  
6 fmin=f/10;  
7 disp('HZ',fmin*1,"fmin=");
```

---

**Scilab code Exa 33.4** frequency

```
1 clc;  
2 R=51*10**3;  
3 C=0.001*10**-6;  
4 f0=1/(2*%pi*R*C);  
5 disp('HZ',f0*1,"f0=");
```

---

## Chapter 34

# REGULATED POWER SUPPLIES

Scilab code Exa 34.1 value of line regulation

```
1 clc ;
2 //e.g 34.1
3 VL=100*10**-6;
4 VS=5;
5 LR=VL/VS;
6 disp( 'microV/V' ,LR*10**6 , "LR=" );
```

---

Scilab code Exa 34.2 Change in output voltage

```
1 clc ;
2 //e.g 34.2
3 LR=1.4*10**-6;
4 VS=10;
5 //LR=VL/VS;
6 VL=LR*VS
7 disp( 'microV' ,VL*10**6 , "VL=" );
```

---



Scilab code Exa 34.3 value of load regulation

```
1 clc;
2 //e.g 34.3
3 IL=40*10**-3;
4 VNL=8;
5 VFL=7.995;
6 LR=(VNL-VFL)/IL;
7 disp('microV/mA',LR*10**3,'LR=');
```

---

Scilab code Exa 34.4 voltage under full load

```
1 clc;
2 //e.g 34.4
3 VNL=5;
4 IL=20*10**-3;
5 LR=10*10**-6;
6 //LR=(VNL-VFL)/IL;
7 VFL=VNL-IL*LR;
8 disp('V',VFL*1,'VFL=');
```

---

Scilab code Exa 34.5 magnitude of variation in output voltage

```
1 clc;
2 //e.g 34.5
3 V0=10;
4 R=0.00002
5 VAR=V0*R;
6 disp('mV',VAR*10**3,'VAR=');
```

---

Scilab code Exa 34.6 load voltage voltage drop and current

```
1 clc;
2 //e.g 34.6
3 vs=30;
4 rs=240;
5 vz=12;
6 rl=500;
7 vl=vz;
8 disp('V',vl,"vl=");
9 Is=(vs-vz)/rs
10 Vd=Is*rs;
11 disp('V',Vd*1,"Vd=");
12 Iz=Is-(vl/rl)
13 disp('A',Iz*1,"Iz=");
```

---

Scilab code Exa 34.7 min and max value of input voltage

```
1 clc;
2 //e.g 34.7
3 Vz=5.1;
4 rz=10;
5 Izmin=1*10**-3;
6 Izmax=15*10**-3;
7 Rs=600;
8 Vomn=Vz+Izmin*rz;
9 disp('V',Vomn*1,"Vomn=");
10 Vsmin=Izmin*Rs+Vomn;
11 disp('V',Vsmin*1,"Vsmin=");
12 Vomax=Vz+Izmax*rz;
13 disp('V',Vomax*1,"Vomax=");
```

```
14 Vsmax=Izmax*Rs+Vomax;  
15 disp('V',Vsmax*1,"Vsmax=");
```

---

Scilab code Exa 34.8 min and max value of load current

```
1 clc;  
2 //e.g 34.8  
3 Vs=24;  
4 Rs=500;  
5 Vz=12;  
6 Izmin=3*10**-3;  
7 Izmax=90*10**-3;  
8 rz=0;  
9 Is=(Vs-Vz)/Rs;  
10 disp('mA',Is*10**3,"Is=");  
11 ILmax=Is-Izmin;  
12 disp('mA',ILmax*10**3,"ILmax=");  
13 RLmin=Vz/ILmax;  
14 disp('ohm',RLmin*1,"RLmin=");
```

---

Scilab code Exa 34.9 min and max value of zener current

```
1 clc;  
2 //e.g 34.9  
3 Vsmin=22;  
4 Rs=1*10**3;  
5 Vz=10;  
6 RL=2*10**3;  
7 Vsmax=40;  
8 IL=Vz/RL;  
9 disp('mA',IL*10**3,"IL=");  
10 Izmax=((Vsmax-Vz)/Rs)-IL;  
11 disp('mA',Izmax*10**3,"Izmax=");
```

```
12 Izmin=((Vsmin-Vz)/Rs)-IL;
13 disp('mA',Izmin*10**3,"Izmin=");
```

---

Scilab code Exa 34.10 max value of Rs and power

```
1 clc;
2 Vz=10;
3 Vsmin=13;
4 Vsmax=16;
5 ILmin=10*10**-3;
6 ILmax=85*10**-3;
7 Izmin=15*10**-3;
8 Rsmx=(Vsmin-Vz)/(Izmin+ILmax);
9 disp('ohm',Rsmx*1,"Rsmx=");
10 Izmax=((Vsmax-Vz)/Rsmx)-ILmin;
11 Pzmax=Izmax*Vz;
12 disp('W',Pzmax*1,"Pzmax=");
```

---

Scilab code Exa 34.11 regulated resistance

```
1 clc;
2 Vsmin=19.5;
3 Vsmax=22.5;
4 RL=6*10**3;
5 Vz=18;
6 Izmin=2*10**-6;
7 Pzmax=60*10**-3;
8 rz=20;
9 Izmax=sqrt(Pzmax/rz);
10 IL=Vz/RL;
11 ILmax=IL;
12 ILmin=IL;
13 Rsmx=(Vsmin-Vz)/(Izmin+ILmax);
```

```
14 disp('ohm',Rsmx*1,"Rsmx=");
15 Rsmn=(Vsmx-Vz)/(Izmx+ILmn);
16 disp('ohm',Rsmn*1,"Rsmn=");
```

---

Scilab code Exa 34.12 min and max value of zener current

```
1 clc;
2 Vsmin=8;
3 Vsmax=12;
4 Rs=2.2*10**3;
5 Vz=5;
6 RL=10*10**3;
7 Ismin=(Vsmin-Vz)/Rs;
8 Ismax=(Vsmax-Vz)/Rs;
9 IL=Vz/RL;
10 Izmin=Ismin-IL;
11 disp('mA',Izmin*10**3,"Izmin=");
12 Izmax=Ismax-IL;
13 disp('mA',Izmax*10**3,"Izmax=");
```

---

Scilab code Exa 34.13 zener regulator

```
1 clc;
2 VL=5;
3 Vz=5;
4 IL=20*10**-3;
5 Pzmax=500*10**-3;
6 Vsmax=15;
7 Vsmin=9;
8 Izmax=Pzmax/Vz;
9 Ismax=IL+Izmax;
10 Vz=VL;
11 Rsmn=(Vsmax-Vz)/(Izmax+IL);
```

```
12 disp('ohm',Rsmin*1,"Rsmin=");
13 ILmax=IL;
14 Iz=((Vsmin-Vz)/Rsmin)-ILmax;
15 disp('mA',Iz*10**3,"Iz=");
```

---

Scilab code Exa 34.14 regulated voltage and circuit current

```
1 clc;
2 Vz=10;
3 Vbe=0.7;
4 RL=100;
5 Vs=15;
6 B=100;
7 Rs=33;
8 VL=Vz+Vbe;
9 IL=VL/RL;
10 Is=(Vs-VL)/Rs;
11 Ic=Is-IL;
12 Ib=Ic/B;
13 disp('microA',Ib*10**6,"Ib=");
```

---

Scilab code Exa 34.15 voltage current

```
1 clc;
2 Vs=15;
3 Vz=8.3;
4 B=100;
5 R=1.8*10**3;
6 RL=2*10**3;
7 Vbe=0.7;
8 VL=Vz-Vbe;
9 Vce=Vs-VL;
10 IR=(Vs-Vz)/R;
```

```

11 IL=VL/RL;
12 IB=IL/B;
13 disp('microA',IB*10**6,"IB="); //In question beta is
    100 but while solving it is taken as 50 which is
    wrong
14 Iz=IR-IB;
15 disp('mA',Iz*10**3,"Iz=");

```

---

Scilab code Exa 34.16 max value of Resistance and power

```

1 clc;
2 ILmin=0;
3 ILmax=2;
4 VL=12;
5 Vsmin=15;
6 Vsmax=20;
7 B=100;
8 VBE=0.5;
9 Vz=12.5;
10 Izmin=1*10**-3;
11 IBmax=ILmax/B;
12 IR=IBmax+Izmin
13 Rmax=(Vsmin-Vz)/IR;
14 disp('ohm',Rmax*1,"Rmax=");
15 Izmax=(Vsmax-Vz)/Rmax;
16 disp('mA',Izmax*10**3,"Izmax=");
17 Pzmax=Vz*Izmax;
18 disp('W',Pzmax*1,"Pzmax=");
19 PRmax=(Vsmax-Vz)*Izmax;
20 disp('W',PRmax*1,"PRmax=");
21 VCEmax=Vsmax-VL;
22 disp('V',VCEmax*1,"VCEmax=");
23 PDmax=VCEmax*ILmax;
24 disp('W',PDmax*1,"PDmax=");

```

---

Scilab code Exa 34.17 circuit and value of current

```
1  clc;
2  VL=12;
3  IL=200*10**-3;
4  Vs=30;
5  Rs=10;
6  B1=150;
7  Ic1=10*10**-3;
8  VBE1=0.7;
9  B2=100;
10 VBE2=0.7;
11 Vz=6;
12 Rz=10;
13 Iz=20*10**-3;
14 ID=10*10**-3;
15 I1=10*10**-3;
16 RD=(VL-Vz)/ID;
17 disp('ohm',RD*1,"RD=");
18 //a=R1/R2;
19 a=(VL/(Vz+VBE2))-1;
20 Ic2=Ic1;
21 IB2=Ic2/B2;
22 V2=Vz+VBE2;
23 Vz=12;
24 R1=(Vz-V2)/I1;
25 disp('ohm',R1*1,"R1=");
26 R2=R1/a;
27 disp('ohm',R2*1,"R2=");
28 hfe1=B1;
29 IB1=(IL+I1+ID)/hfe1;
30 I=IB1+Ic2;
31 R3=(Vs-(VBE1+VL))/I;
32 disp('Kohm',R3*10**-3,"R3=");
```

---



Scilab code Exa 34.18 vout IL IE PI

```
1 clc;
2 Vs=25;
3 Vz=15;
4 RL=1*10**3;
5 VBE2=0.7;
6 Vout=(Vz/2)+VBE2;
7 disp('V',Vout*1,"Vout=");
8 IL=Vout/RL;
9 IE1=IL;
10 disp('mA',IE1*10**3,"IE1=");
11 Vce1=Vs-Vout;
12 P1=Vce1*IE1;
13 disp('mW',P1*10**3,"P1=");
```

---

Scilab code Exa 34.19 min and max value of voltage

```
1 clc;
2 IADJ=100*10**-6;
3 Vin=35;
4 VREF=1.25;
5 R2=0;
6 R1=220;
7 Voutmin=VREF*(1+(R2/R1))+IADJ*R2;
8 disp('V',Voutmin*1,"Voutmin=");
9 R2=5000;
10 Voutmax=VREF*(1+(R2/R1))+IADJ*R2;
11 disp('V',Voutmax*1,"Voutmax=");
```

---

Scilab code Exa 34.20 regulated voltage

```
1 clc;  
2 R1=220;  
3 R2=1500;  
4 Vo=1.25*(1+(R2/R1));  
5 disp('V',Vo*1,"Vo="); //answer given in book is wrong
```

---

Scilab code Exa 34.21 regulated dc output voltage

```
1 clc;  
2 R1=240;  
3 R2=2.4*10**3;  
4 Vo=1.25*(1+(R2/R1));  
5 disp('V',Vo*1,"Vo=");
```

---