
Learning Python with Raspberry Pi

for electronic engineers



Dogan Ibrahim



elektor

LEARN > DESIGN > SHARE

Preface	11
Chapter 1 • Raspberry Pi 4	13
1.1 Overview	13
1.2 Parts of the Raspberry Pi 4	13
1.3 Requirements of the Raspberry Pi 4	14
1.3.1 Setup Option 1	16
1.3.2 Setup Option 2	17
1.4 Summary	18
Chapter 2 • Setting Up the Raspberry Pi 4	19
2.1 Overview	19
2.2 Installation Steps	19
2.3 Powering Up your Raspberry Pi 4	21
2.4 Remote Access	24
2.4.1 Configuring the Putty	27
2.5 Remote Access of the Desktop	27
2.6 Summary	29
Chapter 3 • Using the Command Line	30
3.1 Overview	30
3.2 The Raspberry Pi Directory Structure	30
3.3 File Permissions	31
3.4 Help	35
3.5 Date, Time, and Calendar	36
3.6 File Operations	36
3.7 System and User Information	38
3.8 Resource Monitoring on Raspberry Pi	40
3.9 Shutting Down	42
Chapter 4 • Using a Text Editor in Command Mode	44
4.1 nano Text Editor	44
4.2 Summary	47
Chapter 5 • Creating and Running a Python Program	48
5.1 Overview	48
5.2 Method 1 – Interactively from Command Prompt	48

- 5.3 Method 2 – Create a Python File in Command Mode. 49
- 5.4 Method 3 – Create a Python File in GUI mode 49
- 5.5 Which Method? 50
- 5.6 Summary 50
- Chapter 6 • Python Programming 51**
- 6.1 Overview 51
- 6.2 Variable Names 51
- 6.3 Reserved Words 52
- 6.4 Comments 52
- 6.5 Line Continuation 52
- 6.6 Blank Lines 52
- 6.7 More Than One Statement on a Line 53
- 6.8 Indentation 53
- 6.9 Python Data Types 53
- 6.10 Numbers 54
- 6.11 Strings 57
- 6.11.1 String Functions 58
- 6.11.2 Escape Sequences 59
- 6.12 Print Statement 60
- 6.13 List Variables 61
- 6.13.1 List Functions 62
- 6.14 Tuple Variables 62
- 6.15 Dictionary Variables 63
- 6.15.1 Dictionary Functions 63
- 6.16 Keyboard Input 64
- 6.17 Comparison Operators 64
- 6.18 Logical Operators 65
- 6.19 Assignment Operators 65
- 6.20 Control of Flow 65
- 6.20.1 if, if-else, and elif 65
- 6.20.2 for Statement 66
- 6.20.3 while Statement 68

6.20.4 continue Statement.	68
6.20.5 break Statement.	69
6.20.6 pass Statement	69
6.21 Case Study 1 – 4 Band Resistor Colour Code Identifier.	70
6.22 Case Study 2 – 4 Band Resistor Colour Code Identifier Including Small Resistors. . 72	
6.23 Case Study 3 – Series or Parallel Resistors	74
6.24 Case Study 4 – Resistive Potential Divider	76
6.25 Trigonometric Functions	78
6.26 User-defined Functions	79
6.27 Example Programs.	82
6.28 Case Study 5 - Resistive Attenuator Design – Equal Source & Load Resistances	100
6.29 Case Study 6 - Resistive Attenuator Design – Unequal Source & Load Resistances	103
6.30 Recursive Functions	105
6.31 Exceptions	106
6.31.1 try/finally Exceptions.	108
6.32 Case Study 7 – Zener Diode Based Voltage Regulator	109
6.33 Date and Time.	113
6.34 Creating Our Own Modules	114
6.35 Summary	116
Chapter 7 • Plotting Graphs With Python	117
7.1 Overview	117
7.2 The Matplotlib Graph Plotting Library	117
7.3 Case Study 8 – RC Transient Circuit Analysis - Charging.	130
7.4 Case Study 9 – RC Transient Circuit Analysis - Discharging.	132
7.5 Transient RL Circuits	135
7.6 Case Study 10 – RCL Transient Circuit Analysis.	136
7.7 Summary	139
Chapter 8 • Files in Python With the Raspberry Pi	140
8.1 Overview	140
8.2 Python File Operations	140

8.3 Case Study 11 – RC Circuit Frequency Response	146
8.4 Case Study 12 – Save Raspberry Pi 4 CPU Temperature in a File	148
8.5 Saving Data on an External USB Memory Stick	150
8.6 Case Study 13 – Save Raspberry Pi 4 CPU Temperature on Memory Stick	152
8.7 Summary	154
Chapter 9 • Array and Matrix Operations With Python	155
9.1 Overview	155
9.2 Arrays	155
9.2.1 Array Operations and Functions	156
9.2.2 Array Multiplication	156
9.2.3 Copying Arrays	157
9.3 Systems of Linear Algebraic Equations	157
9.4 Case Study 14 – DC Circuits Mesh Analysis 1	160
9.5 Case Study 15 – DC Circuits Mesh Analysis 2	163
9.6 Case Study 16 – DC Circuits Mesh Analysis 3	164
9.7 Case Study 17 – DC Circuits Node Analysis 1	165
9.8 Summary	168
Chapter 10 • Using the Tkinter Graphical User Interface (GUI) in Python	169
10.1 Overview	169
10.2 GUI with the Tkinter.	169
10.2.1 Label	170
10.2.2 Button	173
10.2.3 Message	178
10.2.4 Entry	179
10.2.5 Grid.	180
10.2.6 Radio Button	181
10.2.7 Checkbox.	185
10.2.8 Dialogs	187
10.2.9 Scale (Slider)	190
10.2.10 Menu	192
10.2.11 Binding to Events	194
10.3 Case Study 18 – Resonance in Series RLC Circuits.	196

10.4 Case Study 19 – Inductance of a Single Layer Coil	200
10.5 Summary	202
Chapter 11 • BJT Transistor Circuit Analysis and Design	203
11.1 Overview	203
11.2 BJT Transistor DC Analysis	203
11.2.1 Collector Feedback Biasing	203
11.3 Case Study 20 – Analyzing Collector Feedback Biasing	203
11.4 Voltage Divider Biasing	205
11.5 Case Study 21 – Analyzing Voltage Divider Biasing	206
11.6 Case Study 22 – Designing Transistor Amplifier Circuit	208
11.7 Summary	213
Chapter 12 • Active Filters	214
12.1 Overview	214
12.2 Case Study 23 – Designing Low-Pass Active Filters	214
12.3 High-Pass Filters	219
12.4 Band-Pass Filters	219
12.5 Summary	220
Chapter 13 • Accessing Raspberry Pi 4 Hardware and Peripheral Devices From Python	221
13.1 Overview	221
13.2 GPIO – Parallel Interface	222
13.2.1 The GPIO Library	222
13.2.2 Pin Numbering	223
13.2.3 Channel (I/O port pin) Configuration	223
13.2.4 Case Study 24 – Flashing an LED	226
13.3 PWM	227
13.3.1 Case Study 25 – Changing the Brightness of an LED	228
13.4 I2C	229
13.4.1 Case Study 26 – Using I2C LCD	230
13.5 SPI	233
13.5.1 Case Study 27 – Using SPI – Analog Temperature Sensor	234
13.6 The serial	239

13.6.1 Case Study 28 – Using Serial Communication – Serial Loopback	239
13.7 Summary	241
Chapter 14 • Python and the Internet on Raspberry Pi 4	242
14.1 Overview	242
14.2 Internet Communication Protocols	242
14.3.1 Case Study 29 – Sending a Text Message to a Mobile Phone Using TCP/IP	243
14.3.2 Case Study 30 – Communicating with a PC Using TCP/IP	246
14.3.3 Case Study 31 – Controlling an LED Connected to Raspberry Pi From Mobile Phone Using TCP/IP	249
14.4 UDP Based Communication	251
14.4.1 Case Study 32 – Sending a Text Message to a Mobile Phone Using UDP.	252
14.4.2 Case Study 33 – Controlling an LED Connected to Raspberry Pi From Mobile Phone Using UDP	254
14.5 Using Flask to Create a Web Server to Control Raspberry Pi GPIO Ports From the Internet	255
14.5.1 Case Study 34 – Web Server - Controlling an LED Connected to Raspberry Pi Using Flask	257
14.6 Summary	261
Chapter 15 • Bluetooth Communication on Raspberry Pi 4 Using Python.	262
15.1 Overview	262
15.2 Case Study 35 – Bluetooth Control of LED From a Mobile Phone	262
15.3 Summary	268
Appendix A • Using wxPython Graphical User Interface	269
A.1 wxPython Template	269
A.2 Some Example Widgets	270
A.3 Case Study 36 – Display the Raspberry Pi 4 CPU Temperature Using wxPython . .	276
Appendix B • Object-oriented Programming	279
B.1 Classes and Methods	279
B.2 Variables	280
B.3 Inheritance.	281