

# **HLUVUKANIe LABs**

### DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING TRAINING (DEEET)

### SCHOOL OF SOLAR ENERGY

STUDY GUIDE FOR

COURSE: Introduction to Microcontroller Programming COURSE CODE: CIP01 COURSE DURATION: Two days COURSE CREDITS: 2

COMPILED BY: N.E Mabunda

2022

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# **TABLE OF CONTENTS**

INDEX					
1.	INTRODUCTION	3			
2.	GENERAL INFORMATION	3			
3.	POGRAMME DEFINITION	4			
4.	GENERIC ENGINEERING STANDARDS	4			
5.	UNITS OF LEARNING	5			
6.	ASSESMENT DETAILS	6			

## 1. INTRODUCTION

Welcome to the Short Learning Program (SLP) for the introduction to microcontrollers and C programming. The candidates are required to have covered elsewhere grade nine (or equivalent) algebra, basic electricity/ electronics or science and basics of computers. The course will not dwell onto fundamentals of computers but rather look at their applications for programming of microcontrollers. In the course, Arduino microcontroller board features are evaluated. The Arduino Integrated Development Environment (IDE) basic programming tools are explored. Candidates are taught to develop firmware that they transfer to the ATMega328 microcontroller to accomplish the required activity.

#### Short history of microcontroller

It was during 1970 and 1971 when Intel was working on inventing the world's first microprocessor, that Gary Boone of Texas Instruments was working on quite a similar concept and invented the microcontroller. Boone designed a single integrated circuit chip that could hold nearly all the essential circuits to form a calculator; only the display and the keypad were not incorporated. Surprisingly, this exceptional breakthrough in the field of electronics and communication was rather given a mundane name of TMS1802NC; however, the device wasn't ordinary. It had five thousand transistors providing 3000 bits of program memory and 128 bits of access memory!! So, it was possible to program it to perform a range of functions.

Intel created many significant microcontrollers besides producing the world's first ever microprocessor. The important ones produced by Intel are the 8048 and the 8051 microcontrollers. 8048 was introduced in 1976 and was the first of Intel's microcontrollers. It was used as the processor in the PC keyboard of IBM. The 8051 microcontroller was introduced in 1980 and is one of the most popular microcontrollers. It is even used now and is one of the most long-lived microcontrollers (Also go through: 8051 Microcontroller Projects & Circuits)

#### 2. GENERAL INFORMATION

This course will be provided in a form of two-day workshop, attendance certificate will be issued. Queries related to this course may be directed via WhatsApp **or physical call.** 

Your instructor is Dr. Nkateko E Mabunda, Cellphone no: +2784 535 3108

### 3. PROGRAMMEME DEFINITION

SLP NAME	:	Introduction to Microcontroller Programming				
CODE	:	CIP01				
NQF LEVEL	:	6				
MODULE PRE-REQUISITE	:	Prior science, algebra, and computer knowledge				
MODULE DURATION	:	16 HOURS				
MODULE RANGE	:	The course will enhance your knowledge and skills of microcontrollers and creation of basic C programs.				
PRE-KNOWLEDGE:	:	The learner is expected to possess a prior knowledge in computing, electricity or science, and algebra.				
I EACHING AND LEARNING STRATEGIES	:	The program is presented for two days. Attendance certificates are issued. There assessments will be in a practical form,				

References: Arduino IDE and online resources.

## 4. GENERIC ENGINEERING STANDARDS

The following standards will be used in the presentation of this module:

- Proven Engineering philosophies, principles, processes, procedures and practices
- Industrial norms and standards and manufacturer specifications
- SABS Quality standards and parameters
- Occupational Health and Safety Act
- Quality assurance norms as established by HEQC and internal university assurance policies
- Quality assurance norms as established by The Engineering Council of South Africa (ECSA)

Please adhere to all covid-19 regulations

# 5. UNITS OF LEARNING

Unit (duration)	Syllabus	Reference	
Arduino hardware,	On completion of this unit, the candidate will be	IDE help files	
peripherals, and IDE		and online	
(2 hours)	<ul> <li>Describe the units within Arduino board as well as the board features,</li> <li>understand housekeeping activities that are necessary to prepare the IDE</li> <li>and describe the role of header files as well as libraries.</li> </ul>	Tesources	
Communications with	On completion of this unit, the candidate will be	IDE help files	
Arduino analog and	able to:	and online	
digital ports (3 hours)	<ul> <li>blink or create lighting patterns to external connected LEDs and</li> <li>read voltages across the connected potentiometer.</li> </ul>	resources	
Serial communications	On completion of this unit, the candidate will be	IDE help files	
(1hr)	<ul> <li>able to:</li> <li>effectively utilize serial monitor and other third-party serial communications tools (e.g., cool terminal) to display external acquired or Internal Arduino generated values</li> </ul>	and online resources	
Assessment 1: solar	<ul> <li>This exercise test student's ability to</li> </ul>		
energy logger (1hr)	read, manipulate external data and report the produced result.		
Loops, conditional	On completion of this unit, the candidate will be	IDE help files	
statements, and Boolean	<ul> <li>Do basic event counting</li> </ul>	and online	
functions (3 hrs.)	<ul> <li>and program the microcontroller to do condition-based switching</li> </ul>	resources	
Standalone	On completion of this unit, the candidate will be	IDE help files	
microcontroller circuits	<ul> <li>simplify complex traditional electronic</li> </ul>	and online	
(2hrs)	circuits to use of microcontrollers	resources	
Assessment 2:	This exercise test student's ability to		
Microcontroller based day	read and use external data conditions for switching.		
/night controller			

## 6. ASSESMENT DETAILS

#### 6.1 Practical Assignment task 1

Develop an Arduino code that will monitor a 3.7 V battery charge status, when it is subjected to the voltage that is produced by a five volt/ one-watt mini photovoltaic panel. You will use the two channels from the analog to digital converter pins of the Arduino board.

#### 6.2 Practical Assignment task 2

Develop an Arduino code that employs a simple series resistor-LDR network and the motion detector to energize a relay circuit that switches all connected 230 Volt lights ON/OFF.

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EVALUATOR:							
STUDENT NAME:							
PROJEC TITLE							
			CON	AMENTS	S		
LEVEL		/30					
Has basics of electronics been applied?							
Has additional technical knowledge been applied?							
WAS THE BEST SULUTION CHOSEN							
Was an effort made to evaluate several alternatives?							
Was the best solution for the project finally chosen?							
QUALITY, EFFICIENCY, COST EFFECTIVENESS							
Does the hardware comply with ergonomic, health and safety norms and ECSA standards?							
Has project maintenance been considered?							

Has project maintenance been considered?		
Has the project been designed in a modular format?		
What is the quality of the workmanship?		
TOTAL		
FUNCTIONALITY FACTOR (0-1)		
FINAL= TOTAL X FUNCTIONALITY FACTOR	/100	