# DEDICATION AND ACKNOWLEDGMENT

We want to dedicate our mini project towards our lecturer, Madam Rashidah. She has been a very supportive teacher and would always help us in every hardship that we faced during the mini project. Even though we always bother her with questions but she still response to us with an open heart. She also had monitored us thoroughly during the mini project so the flow of making the project done is easy for us. We learnt a lot and received many usable information throughout this project.

We want to thank our family for always be there for us to support us mentally and academically during our times in UTM. They love to ask about our financial status and that had always ease us as a student.

Finally, we would love to give dedication to our friends that were the closest with us during the most of our time in UTM. They helped us a lot in academics and at times when we were at our lowest. They were very essential for our success in academics. All in all, we are happy to be a part of this mini project because it gave a big impact to us in every way. We hope we can experience a very interesting and challenging project like this again.

# The Background

In this mini project we will implement 3 different components on a single GAL device, those components are

* 3-bit Count Up Counter
* 3-bit Comparator
* Clock Disabler

# The Problem

User initialized the amount of copies, the counter counted the number of copies that had been photocopied. The machine stops when the required number of copies is produced.

# Objectives

The objectives of this laboratory are to introduce the students to :

* The development of a PLD device
* A simple Hardware Description Language

# The flowchart

Start

Install WinCUPL 5.0 Software

Make 2-Bit and 3-Bit coding using the software

# Component and requirements

* Switches : to set the required number of copies
* Counter : to count the number of copies that has been made
* Comparator : to compare the number of copies required with the number of copies produced
* Clock Disabler : to stop the operation of the counter

# Materials and software used

* 1. Breadboard
  2. GAL 22V10
  3. ETS-5000 Digital Training Kit
  4. Wellon Universal Programmer & Tester
  5. WinCUPL 5.0 Software
  6. Handouts :
* “WinCUPL user manual”
* “GAL22V10 Data Sheet”
* “How to use Wellon Programmer”
* “How to use winCUPL 5”

# Circuit Implementation

* **2-bit Circuit Implementation**

Pin 1 is the counter power of the clock. The counter displays the printer's number of copies printed. Pin 2 and Pin 3 is a reset and preset button that resets the original 0 copy number. The user should control the inputs A0 and A1 to estimate the number of copies they want. Every switch is just one bit B0 and B1 are the comparator of output, Q0 and Q1. 2-Bit circuit only requires a BCD connection to A and B while the others have a GND connection. Finally, when the maximum number of copies exceeded the number of user copies, Pin 16 and 17 are connected to LED display 7 and 3 displaying color changes.

* **3-bit Circuit Implementation**

Pin 1 acts as the counter control of the clock. The counter displays the printer's number of copies printed. Pin 2 and Pin 3 is a reset and preset button that resets the initial 0 copy number. Thus, render it 3-bit inputs, an additional input is added this time. A0, A1 and A2 are the user's inputs to decide how many copies they like. Each switch is a single bit. The comparator also increases by one, B0,B1 and B2. This compares the number of copies with the output, Q0,Q1 and Q2. 3-Bit circuit needed to connect BCD to A, B and C while connecting D to GND. Last but not least, Pin 16 and 17 are linked to LED Display 7 and 3 displaying color changes when the maximum number of copies exceeded the number of copies made by the user.

# Physical System Implementation

1.**Input Switch**

We use 3 switches to enter the number of copies we want to print. The single bit, which is A0,A1 and A2.A0, representing the LSB and the MSB represented by A2 can be represented by just one switch. To implement this computer, the user has to key in the number of copies they want as the input, which only allows the required number from 0 to 7. The output will be provided to the user

2. **3-bit Count Up Counter**

The 3-bit counter we used is the negative edge of the 3-bit Dual JK flip-flop. If this unit has an edge of the clock signal, the counter will have to count We decide when the clock will stop counting and when to start counting by implementing GAL programmed code as in WinCUPL. We need to make a condition in that code when it is supposed to stop counting. Before running this mini project, we also developed 2-bit and 3 bit coding. We need to translate the code in the PLD file into JED file because in the laboratory the JED software is burned into ATMEL 22V10 using a Wellon programmer.

3. **3-bit Comparator**

To compare the value from two sources, the input switch and the counter, the comparator uses three 2-input XNOR gates. If the input is the same for the two input sources, the output is 0 and the output is sent to NOT gate, converting it to 1 and presenting it as high. Consequently, if all inputs from the input switches and counter are the same, the output will be 0 and sent to the clock enabler and the photocopying machine will be stopped.

4. **Clock Enabler/Disabler**

The clock disabler is designed to disable the clock, when the quantity of copies and printed is the same, it is used to prevent counteractivity. Only when all input is high can the clock enabler be allowed, so it is sent to counter to count the number of copies.