

**ANALOGUE ELECTRONIC TRAINER (BJT)**

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**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

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**This report is submitted in partial fulfillment of the requirement for the award of Bachelor  
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BORANG PENGESAHAN STATUS LAPORAN  
PROJEK SARJANA MUDA II

Tajuk Projek : ANALOGUE ELECTRONIC TRAINER (BJT)

Sesi Pengajian : 

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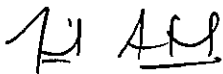
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For my beloved mom, dad and family

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## ABSTRACT

In study center, students often used a trainer while experimenting in the laboratory; it becomes a dependable kits for user. This study explored the bipolar junction transistor (BJT) circuit theory, safety of laboratory practices and compliances standard for trainer operating. The purpose of this project is to explore students and lectures with the new environment of trainer usage; multiple design of BJT circuit by using 1 base trainer with portable component. Thus, the objective of this project is producing a multiple design trainer, to create a trainer that friendly user and to reduce the space of storing system. The approach or methodology of this project is included with software and hardware. The software used in developing the project is solid works, multisim and proteus while the hardware has produced as a prototype. It utilizes a bipolar junction transistor (BJT) circuit configuration on DC analysis and Ac analysis. Highly secured in safety, reliability, low cost and user friendly trainer is expected to be developed. Commercialize to study center at university or college is a high possibility.



## ABSTRAK

Sudah menjadi kebiasaan di pusat-pusat pengajian, para pelajar menggunakan trainer sebagai alat bantu semasa proses ujikaji di makmal. Projek ini mengeksploitasi terhadap litar bipolar junction transistor (BJT), ciri-ciri keselamatan dalam makmal ujikaji serta pematuhan piawaian operasi trainer. Tujuan utama projek ini adalah untuk menukar pandangan dan suasana ujikaji kepada pelajar dan pensyarah dalam penggunaan trainer iaitu pelbagai rekabentuk dalam litar BJT dengan menggunakan 1 trainer asas berserta komponen mudah alih. Oleh itu, objektif projek ini adalah untuk menghasilkan pelbagai rekabentuk litar BJT, trainer mesra pengguna serta mengurangkan tempat penyimpanan trainer di makmal. Projek ini menggunakan pendekatan perisian serta perkakasan. Perisian yang digunakan adalah solid works, multisim dan proteus manakala perkakasan dijadikan sebagai prototaip. Projek ini merangkumi litar operasi bipolar junction transistor (BJT) terhadap analisis DC dan AC. Sangat dijamin dalam keselamatan, kebolehpercayaan, kos rendah dan trainer mesra pengguna adalah jangkaan hasil projek ini. Mengkomersialkan untuk digunakan di pusat pengajian seperti di universiti atau kolej adalah sangat tinggi

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## LIST OF ABBREVIATIONS

AC	–	Alternating Current
ARES	-	Advanced Routing and Editing Software
BJT	-	Bipolar Junction Transistor
CNC	–	Computerized Numerical Control
DC	–	Direct Current
FET	-	Field Effect Transistor
GND	-	ground
ISIS	-	Intelligent Schematic Input System
OP-AMP	-	Operational Amplifier
PCB	–	Printed Circuit Board
UV	–	Ultra Violet
VSM	-	Virtual system Modelling



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## **CHAPTER I**

### **INTRODUCTION**

This chapter will give an overview of the project such as project overview, project objective, project scope, project methodology and the structure of this project report. This chapter will explain briefly about the work from the beginning until the project is implemented.

#### **1.1 Project Overview**

The trainer is a training kit that normally used in the laboratory either at school, college or university. Most of the students assemble their experiment by using certain a trainer such as a common emitter trainer, FET trainer and so on. Unfortunately, each of the trainers is fixed with one design and all the components are mounted in.

Analogue electronic is a required subject for industrial electronic students. Indeed analogue electronic subject requires laboratory experiment by using a trainer. This subject covered in a bipolar junction transistor (BJT) circuit, junction gate Field effect transistor (FET) circuit, and Operational Amplifier (Op-Amp) circuit. Each of the circuits has numerous of trainers available in the market.

This project utilizes a bipolar junction transistor (BJT) circuit configuration on DC analysis and AC analysis. A bipolar junction transistor (BJT) consists of two back-to-back p-n junctions and the contacts are made in all three regions with the two outer regions that called the emitter and collector and the middle region called the base. The device is called “bipolar” since its operation involves both types of mobile carriers, electrons and holes. BJT consists of pn junctions that constructed in a special way and connected in a series connection. The bipolar junction transistor was shaped in terms of three-terminal device with emitter, base and collector. Thus, from the physical structure, BJTs can be divided into two groups; which is npn and pnp transistors. The three terminals were used in three different configurations; common emitter configuration, common base configuration and common base configuration.

Base trainer will be developed in this project as a main trainer. The base trainer is able to plug in a printed circuit board (PCB) BJT printed circuit will be placed on top of the Printed circuit board (PCB) with a printed component. Besides, the PCB board is designed without mounted in for the component. Its only consist space holes to plug in in component while experimenting. In addition, in a single PCB design, it's able to construct six (6) BJT circuit configurations which are fixed bias, emitter bias, voltage divider bias, collector feedback, emitter follower and cascaded configurations. Meanwhile, the component was designed as a portable plug in component with its adapter. Thus, the possibility of applying a JFET configuration is high since the structure of the components is same.

The base trainer exploits in a variable number of inputs. CNC machined plastic components which is Traco component is used instead of transformer. The positive and negative output produced by this Traco component with high efficiency up to 81%. Thus the expecting input powers for this base trainer are  $\pm 15V$ ,  $\pm 9V$  and  $\pm 12V$ . Since, this project is a prototype version; this project will be tested in the laboratory only.

## 1.2 Objective

The objective is an expectation to be achieved by a researcher. The goal of this analogue electronic trainer is to fulfill the needs of user in operating the laboratory experiment. Therefore, some of the objectives that need to be achieved in the project

- ② To develop a multi design of analogue electronic Bipolar Junction Transistor trainer.
- ② To model the trainer that user friendly and user can replace the component easily when its malfunction.
- ② To reduce the space in storing for several designs of laboratory experiment with using one base trainer

## 1.3 Problem Statement

"The problem statement describes the context for the study and it also identifies the general analysis approach" [4].

Normally, the available trainers in the market are designed with a mounted component. Thus, the design is fixed for the consequent trainer. Unfortunately, while experimenting, the module should be followed by the available design and cannot be changed or modified by users.

Next, some electronic components are sensitive to the environment and due to that it may malfunction and requires a replacement. It requires time in replacing it since the component is built in. In addition, some component also not available in this country and since the available trainer is manufactured in India.

Finally, the trainer does require some space in the laboratory storing system since it's required numerous type of design for student experimenting. Moreover, each trainer only available for one (1) designs.

## 1.4 Project Scope

To achieve the objectives, the project is divided into 3 main parts which are trainer base, printed circuit board (PCB) of bipolar junction transistor (BJT) design configuration and component adapter. The scope of this project as below;

- ✓ Focused on student levels and usage.
- ✓ In order to design and construct the circuit, Proteus and multisim software was applied in this project.
- ✓ The plastic or PVC material has been chosen in prototype design because it easy to shape and will not harm consumers. Besides, plastic does not conduct current.
- ✓ The component adapter is designed based on the component size and able to plug in at the base trainer.
- ✓ The tools and method in the project of consists of soldering, disolder, drilling and cutting.

## 1.5 Project Flow Chart

The flow chart for this project is divided into two sections; progression in PSM I and progression in PSM II.

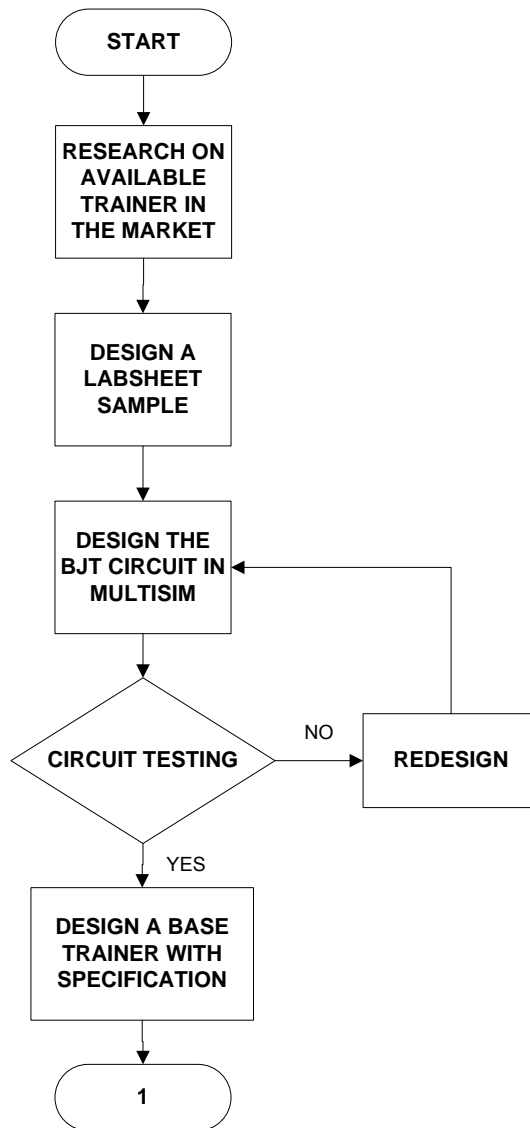


Figure 1.1: Progression on PSM I

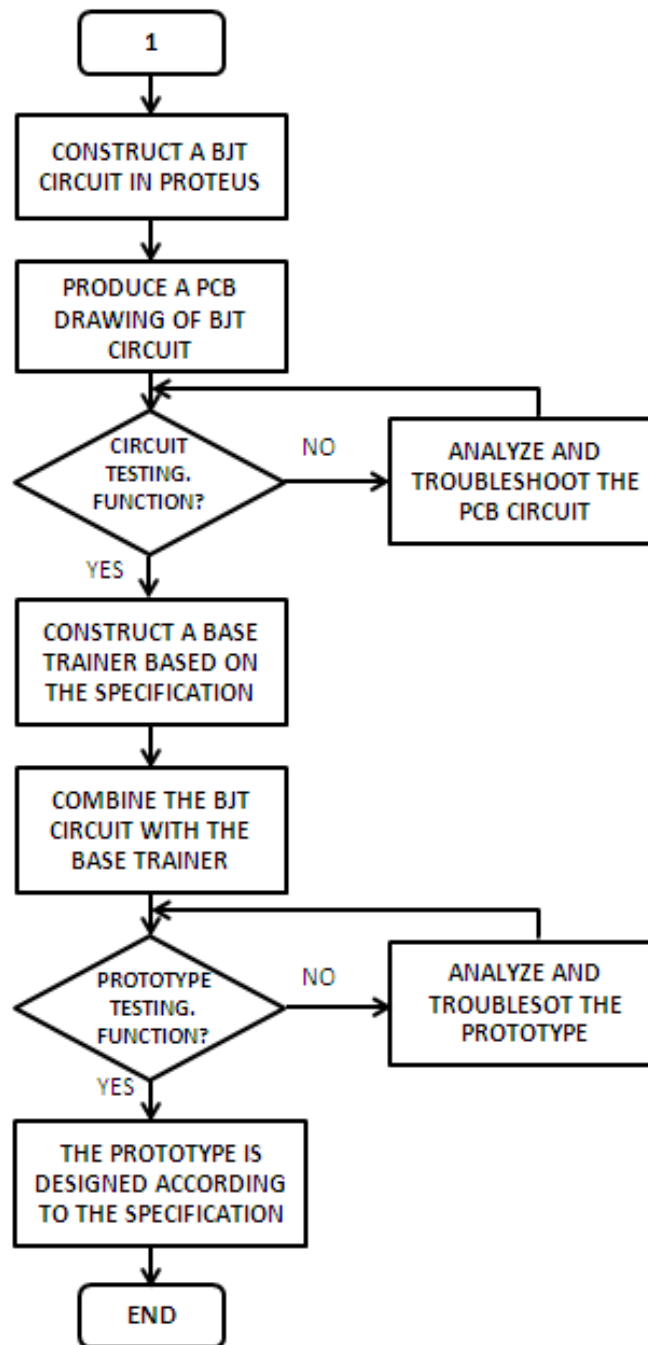


Figure1.2: Progression on PSM II

## Explanation of flow chart

### Progression for PSM I

The project was started by finding and discussion with the supervisor for the title of the research. Research on the available product and the method needed for the project development is starting a week after confirming the project title. The research also includes the theory for bipolar junction transistor configuration circuit that will be used later. As well that, there is a finding from books and the internet that are extremely contributes to this project.

Next, proceed with designing a sample lab sheet for the proposed trainer. The preferred circuit design on a sample lab sheet continued with simulation in multisim. Specification of base trainer and component adapter is designed by using solid works software. The requirement for PSMI seminar is the proposed project with a background study.

### Progression for PSM II

As per second section, the project was continued in developing the hardware and producing the prototype. The product will be produced are PCB board with a BJT design, a base trainer and a component adapter. The method along the project development which is consists of Proteus software, PCB fabrication procedure was applied and its explanation was explained in the chapter III. In order to make the prototype, some of skills were applied such as drilling, soldering and cutting.

As the expected result, the base trainer should be able to function with the plug in PCB BJT board and component adapter. The final project will be present at PSM II seminars and also compete in INOTEK for the consequent year.