UNIVERSITI TEKNIKAL MALAYSIA MELAKA

A FIBER OPTIC SENSOR ON ALKALINE LEVEL DETECTION USING BEAM-THROUGH TECHNIQUE.

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronic Engineering Technology (Telecommunications) with Honours

by

NUR AFIFFA BINTI ISA

B071410768

930913-01-6148

FACULTY OF ENGINEERING TECHNOLOGY

2017

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **A FIBER OPTIC SENSOR ON ALKALINE LEVEL DETECTION USING BEAM-THROUGH TECHNIQUE.**

SESI PENGAJIAN: **2017/2018 Semester 1**

Saya **NUR AFIFFA BINTI ISA**

mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.

☐	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972)
☐	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☑	TIDAK TERHAD	

Disahkan Oleh :

_____ _____

Alamat Tetap:
BATU 15 ½ ANJUNG BATU 2,
JALAN MUAR, 84900
TANGKAK JOHOR.
TARIKH : _____

Cop Rasmi

TARIKH :_____

** Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I hereby, declared this report entitle **„AFIBER OPTIC SENSOR ON ALKALINE LEVEL DETECTION USING BEAM-THROUGH TECHNIQUE„** is the result of my own research except as cited in references.

Signature : ……

Author‟s Name : NUR AFIFFA BINTI ISA

Matric Number : B071410768

Data : ……..

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfilment of the requirement for the degree of Bachelor of Engineering Technology Electronic (Telecommunication) (Hons.). The member of the supervisory is as follow:

Signature	: ……
Name of Supervisor	: MOHD KHANAPIAH BIN NOR
Position	: SUPERVISOR
Date	: ……

ABSTRAK

Kabel gentian optik adalah kabel rangkaian yang mengandungi helai gentian kaca di dalam penebat. Serat mempunyai banyak kegunaan dalam penderiaan jauh. Dalam sesetengah aplikasi, sensor itu sendiri adalah serat optik. Projek ini menumpukan pada Sensor Serat Fiber yang menggunakan penyelesaian alkali untuk menentukan tahap pH. Projek ini adalah untuk membangunkan sensor gentian optik untuk pengesanan tahap alkali menggunakan teknik pengcahayaan dan untuk menganalisis prestasi sensor optik gentian menggunakan teknik statistik. Eksperimen ini melibatkan empat jenis gelombang seperti 850nm, 1300nm, 1310nm, dan 1550nm. Dalam projek ini, menggunakan 5 parameter bermula dari pH 8 hingga pH 12 dengan menggunakan dua jenis kabel gentian optik yang merupakan mod tunggal dan pelbagai mod gentian optik. Jangka masa yang digunakan adalah 30 minit dan hasilnya diambil setiap 1 minit sehingga masa mencapai 30 minit untuk setiap gelombang. Banyak industri seperti makanan farmaseutikal atau sebagainya, penggunaan cecair alkali pada tahap yang berbeza akan menjadi kritikal. Teknik standard yang digunakan untuk pengesanan tahap pH ialah menggunakan meter pH atau kertas litmus. Projek ini akan mencadangkan teknologi baru untuk memahami tahap alkali. Dengan menggunakan gentian optik sebagai sensor untuk mengesan tahap alkali yang berbeza akan menjadi satu lagi kaedah tambahan dalam aktiviti penderiaan.

ABSTRACT

Fiber optic cable is a network cable that contains strands of glass fibers inside an insulated casing. Fibers have many uses in remote sensing. In some applications, the sensor is itself an optical fiber. This project concentrate on Fiber Optic Sensor (FOS) that utilization alkaline solution to determine the pH level. This project is to develop fiber optic sensor for alkaline level detection using beam-through technique and to analyses the performance of fiber optic sensor using statistical technique. This experiments involves four types of wavelength, the wavelength 850nm, 1300nm, 1310nm, and 1550nm. 5 parameter being used start from pH 8 until pH 12 by using two types of fiber optic cable which is single mode and multi-mode fiber optic cable. The time frame used is 30 minutes and result was taken every 1 minute until time reach 30 minutes for each wavelength. In many industries such pharmaceutical food or etc, usage of alkaline liquid in different level would be critical. The standard technique used for pH level detection was used a pH meter or litmus papers. This project will propose new technology to sense alkaline level. By using fiber optic as sensor to detect different level of alkaline would be another additional method in sensing activity.

DEDICATION

Every challenging work needs self efforts as well as guidance of elders especially those who were very close to our heart. This humble effort specially dedicated to my sweet and loving parents and family.

Special dedicated to my family;

Isa Bin A. Bakar
Latifah Binti Abdullah Salim

Which has a lot of encouragement and education and inspiration in success, prays of day and night and always love this self with sincerely heart.

ACKNOWLEDGMENTS

In the name of Allah S.W.T, The most Merciful and The most Passionate, I am grateful to Allah for empowering me to finish this report. Every challenging work needs self efforts as well as guidance of elders especially those who were very close to our heart. This humble effort specially dedicated to my sweet and loving parents and family. I would like to thanks to Mr. Md Ashadi Bin Md Johari as my supervisor and to Mr. Mohd Khanapiah Bin Nor as my second supervisor, lecturer of Faculty Technology Engineering for giving me a full participation and supervision during the making of this final report. Not to be overlooked, I might want to thanks my friends for contributing their thoughts furthermore empower me by giving moral support in finishing this report. In conclusion, I wish to say most profound appreciation to party straightforwardly included and roundabout to finish my project. Every great office you extremely I esteemed.

TABLE OF CONTENT

TABLE OF FIGURE

LIST OF TABLE

LIST OF ABBREVATIONS, SYMBOLS AND NOMENCLATURES

ASE	-	Amplified Spontaneous Emission
dB	-	Decibels
DWDM		Dense Wavelength Division Multiplexing
EMI	-	Electromagnetic Interference
FOS	-	Fibre Optic Sensor
FYP	-	Final Year Project
LED	-	Light Emitting Diode
OSA	-	Optical Spectrum Analyzer
OTDR		Optical Time Domain Reflectometer
pH	-	Power Of Hydrogen
SMF	-	Single-mode fiber
t	-	Time
TCF	-	Thin Core Fiber
UTeM	-	Universiti Teknikal Malaysia Melaka

CHAPTER 1

INTRODUCTION

1.1 Project Background

The fiber optic sensors also called as optical fiber sensors utilize optical fiber or detecting component. Other than detection of pH determination, these sensors are also utilized to detect a few amounts like temperature, pressure, vibrations, displacements, rotations or concentration of chemical species. Fiber have such a variety of uses in the field of remote detecting since they require no electrical power at the remote area. The fiber optic sensor has an optical fiber associated with a light source to take into account recognition in tight spaces or where a little profile is gainful. Fiber optic sensors are incomparable for harsh conditions, including noise, high vibration, extreme heat, wet and unstable situations. These sensors can undoubtedly fit in small areas and can be situated accurately wherever adaptable fiber are required.

This project concentrate on Fiber Optic Sensor (FOS) that utilization alkaline solution to determine the pH esteem. The FOS are more one of a kind since they have many benefits, for example, high sensitivity, extremely flexible dynamic geometry, and the low cost of simplicity, easy installation, possibility of coverage of wide area and possibility of distributed sensor fabrication. Therefore, the aim of this project is to distinguish the alkalinity arrangement with various temperature which are measured with a logarithmic scale called pH.

An alkaline pH level was measure by using a pH meter and litmus papers. In this project focuses on develop of fiber optic sensor of alkaline pH detection for pharmaceutical industries. Development of the fiber optic sensor that has to be able to test the pH level that relate closely to the sensor efficiency in testing the alkalinity substance.

1.2 Problem Statement

Nowadays, the fiber optic sensor in market these days are basically connected with to be used for measuring alkaline pH level, however through changing the association of the course of action the sensor can be tuned to respond to different trigger boost, for instance, pH reaction. The standard technique used for pH level detection was used a pH meter or litmus papers. However, this strategy required exactness when measuring convincing pH plans, liquid suspensions of normal matter or low ionic quality arrangements. Fortunately, these restrictions could be overcome by using optical pH sensors and fiber optic pH sensors. It is exceptionally reasonable to supplant the current customary sensor to detect the alkaline pH level as a result of it phenomenal qualities as far as qualities to the extent precision, offer ease, insignificant exertion and non-contact sort detecting which ready to perform without reaching the example. Additionally, development and trial of a sensor for recognizing the nearness of alkaline as a component of position along an optical fiber length.

1.3 Objective

Student should be able to:

1. To understand or to study about fiber optic sensor.
2. To develop fiber optic sensor for alkaline level detection using beam through technique.
3. To analyses the performance of fiber optic sensor using statistical technique.

1.4 Scope

The scopes of this project are following below:

1. The review and comprehension of fiber optic sensor in alkaline pH level detection.
2. Conduct the experiment using fiber optic to test alkaline solution.
3. Locate the true result of estimation to demonstrate the execution of alkaline pH level.
4. The examination of the outcome utilizing factual procedure.
5. Enhancing the robustness of the plan or procedure to variety.

This project covers the development of fiber optic sensor for alkaline pH level recognition by utilizing statistical technique. This project is to ensure that the project is in the right flow to reach its objectives. The scopes of the project are to study and develop the fiber optic sensor for alkaline pH level detection. This project is alternative way for pharmaceutical industry to determine the alkaline pH level by using fiber optic sensor.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction of Fiber Optic

An optical fiber is a round and hollow dielectric wave-guide made of low-misfortune materials, for example, silica glass. It has a focal center in which the light is guided, implanted in an external cladding of marginally lower refractive index **(Figure 2.1(a)).** Light beams occurrence on the center cladding limit at points more noteworthy than the critical angle experience add up to internal reflection and are guided through the center without refraction. Beams of more noteworthy slant to the fiber hub lose some portion of their power into the cladding at every reflection and are not guided.

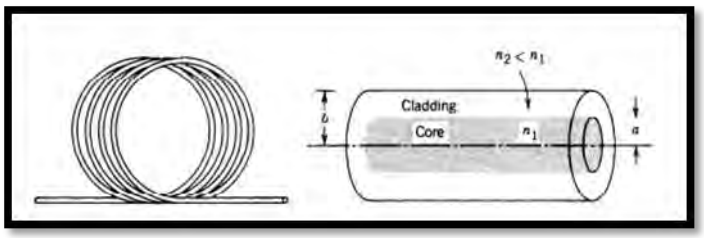

Figure 2.1(a): An Optical Fiber is a Cylindrical Dielectric Waveguide

The optical fiber comprises of the core and the cladding, which have distinctive refractive lists. The light beam goes through the core by over and over skipping off the mass of the cladding **(Figure 2.1(b)).** The light beam, having pass through the fiber with no loss in light amount, is scattered at a point of roughly 60° and discharged to the objective.

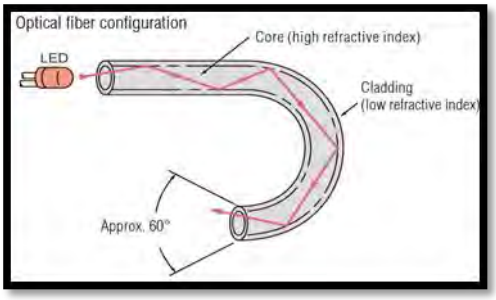

Figure 2.1(b): Optical Fiber Configuration.

The core is divide into the following type:

A. Plastic Type

The core of the plastic-fiber comprises of at least one acrylic-resin fiber 0.25 to 1 mm 0.01" to 0.04" in distance across, encased in a polyethylene sheath. Plastic fiber are light, practical, and adaptable which is the reason they are the most widely recognized kind of fiber sensor.

B. Glass Type

The glass-fiber comprises of 10 to 100 μm 0.39 to 3.94 Mil distance across glass fiber encased in stainless steel tubing. This permits it to be utilized at high working temperatures (350°C 662°F max.).

The optical fiber sensors are separated into two classifications: thrubeam and reflective. The thrubeam sort involves a transmitter and a collector. The reflective sort, which is a single unit, is accessible in 3 sorts: parallel, coaxial, and particular. The 3 depend on the state of the cross-section of the optical fiber.

2.1.1 Type of Fiber Optic

The fiber is a dielectric waveguide comprising of discrete number of propagation modes. In light of the modes, the fiber can be classified as single and multimode furthermore, are talked about as underneath:

A. Multimode Fibre

It has bigger core diameter and relative refractive index than single mode fiber and permits expansive number of modes for the light beams to go through it. These fibers might be additionally arranged as:

i. Multimode Step-Index Fibre

The refractive index of the center is uniform all through and experiences an unexpected or step change at the center cladding limit. Due to its bigger center size (typically 100 μm), more light can be coupled into this sort of fiber. Notwithstanding, there is commonly more signal loss and additionally more signal distortion because of the various ways of light signal that may continue with this bigger fiber.

ii. Multimode Graded-Index Fibre

It is an enhanced multimode step index fiber as far as signal loss and signal distortion. The refractive index of its center is made to change in the illustrative way with the end goal that the most extreme refractive index is at the focal point of the center. Its center size is typically 50 or 62.5 μm.

B. Single mode Fibre

It has little center and just a single pathway of light. The contrast between the refractive index of the center and the cladding is little. SMF has a higher capacity to transmit data as it can hold the loyalty of each light pulse over longer separations and displays no scattering created by the different modes. It has too bring down fiber attenuation than multimode fiber. Its faults are its littler center width making the coupling light into the center more troublesome, troublesome manufacture and higher cost. SMF likewise called single mode step index fiber is examined as underneath:

i. Single Mode Step-Index fibre

It has fundamentally littler focal center measurement (ranging from 8-12 μm) than any of the multimode fiber. Light beams, that enter the fiber, either propagate down the center or are reflected as it were few circumstances. All beams around take after a similar time to travel to every part of the length of the fiber. The cross segment, refractive index profile and light way for various sorts of filaments are appeared in **Figure 2.1.1.**

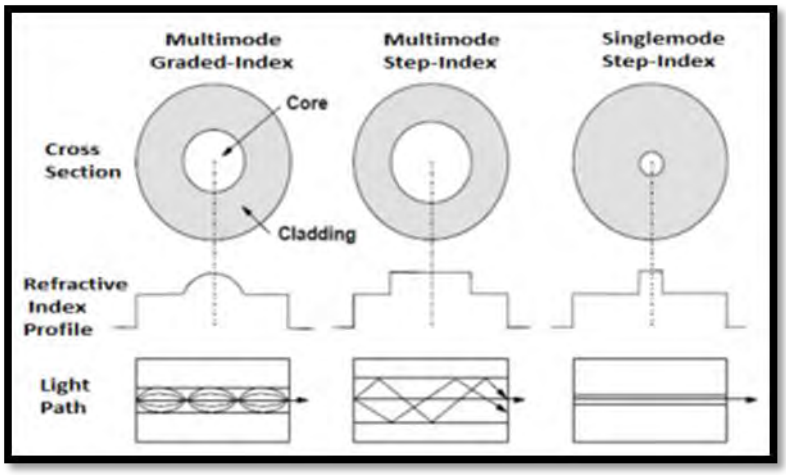

Figure 2.1.1: Different Types of Fibres.