

**UNIVERSITI TEKNOLOGI MARA**

**INVESTIGATION OF BINAURAL  
BEATS AND ISOCHRONIC TONES ON  
BETA AND GAMMA BRAIN WAVE  
FREQUENCIES**

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**Master of Science**

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## AUTHOR'S DECLARATION

I declare that the work in this thesis/dissertation was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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## ABSTRACT

Electrical impulses and chemical activities in human brain generate brain waves at distinct frequency domains between 0.5 and 100 Hz. These domains are associated with different brain activities and are characteristic of different mental states. The cerebral brain cells, which produce the frequency patterns in accordance to the brain activity, can be synchronized to a desired frequency by externally stimulating the cells using acoustical means including binaural beats (BB) and isochronic tones (IT). This thesis presents the preliminary investigation of the effectiveness of IT over BB on stimulating the mental states of alertness and attention on human brain at the Beta (20 Hz) and Gamma (40 Hz) domains. Electroencephalograph (EEG) potentials are measured on 50 healthy male subjects based on the International 10/20 System of Electrode Placement. The results indicate that both pure and embedded IT have an improved effect over BB on the EEG potentials measured at the pre-frontal cortex (PFC) locations by 17% and 36%, respectively, and render a positive influence on the focus and attention mental states of the brain. It also indicates that the embedded signals has an effect comparable to pure signals on the EEG potentials measured at the PFC locations. BB and IT signals embedded in a background audio can provide better listening comfort. The effects of peri-synchronization of pure IT are also investigated and found that the EEG potentials at the anterior frontal region increased by 11.4% and 72.3% from the baseline values at the Beta and Gamma rhythms, respectively.

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# **CHAPTER ONE**

## **INTRODUCTION**

### **1.1 RESEARCH BACKGROUND**

Brain is a unique organ in the human body that contains 100 billion brain cells and small nerve cells named neurons. These neurons communicate with each other to make the brain functions, and the results of the communication are called brain waves. The brain wave patterns can be detected using procedures such as electroencephalography, magnetoencephalography or magnetic resonance imaging.

The brain wave patterns are different depending on the frequency which is measured in pulses per second. There are five frequency domain of brain wave patterns which are Gamma, Beta, Alpha, Theta and Delta. Each frequency domain corresponds to specific mental states and physiological functions' activities. For example, Gamma frequency is found in someone with a highly active mind, and Beta frequency is a frequency of concentration and focus. The brainwave rhythms can be synchronized or entrained by externally applied sound signals including binaural beats and isochronic tones.

### **1.2 PROBLEM STATEMENT**

The thesis aims to investigate the mental state of alertness and attention span on human brains for instance trying to stay focus when one is drowsy or while reading. Common methods to resolve these problems are by taking a break, having coffee, listening to songs and exercises. Nevertheless, a proven method should be considered which uses the brainwave entrainment (BWE) as a solution. BWE is a proven method in enhancing physiological functions of the brain. Various studies have been carried out using a binaural beats (BB), whereas isochronic tones (IT) are not fully studied for BWE. Further research should be done on the combination of the BB and IT for optimal results.