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Extraction and Characterisation of Biodiesel and Glycerine from Waste Cooking Oil

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Abstract: ***Biodiesel is becoming the best substitute for the fuel and the best choice for the green environment without using any renewable resources. The major reason behind in the increase number of the production and research regarding the production of biofuel by waste cooking oil due to the increasing and high consumption use of the product and the depletion of natural resources while producing the biodiesel .it is a derived from various part including vegetable oil, animal fats and waste cooking oil. The paper states the characterization and the production of biodiesel and glycerin from waste cooking oil using two method that is transesterification and microemulsion. Many researchers are trying their best in finding out easy and best method that can be used for converting waste cooking oil in biofuel.***
Keyword: waste cooking oil, microemulsion, transesterification, surfactants.

I. INTRODUCTION

The increase in the no of consumption of biofuel has let the researchers to think of alternatives for it as known that vegetable oil is a great source for the production of biofuel from long time, as a result, using waste cooking oil as a source of biodiesel can be a wonderful choice for producing clean biodiesel, non-toxic to the environment and can be used as renewable fuel using waste cooking oil over other vegetable oil in the production. the biodiesel which is going to be produced from waste cooking oil has its own benefits like it is time consumption, nontoxic in the nature and does not require any additional plant setup for the production.[7] the use of the waste cooking oil in the production does not only have Economical benefit but also environmental benefit too like the raw material required for the production is very cheap and easily available. the global biodiesel producing industry are the fastest growing industry right now. [2-3]



Fig 1.1: waste cooking oil

The types of vegetable used till the date are edible oils are

- Cottonseed oil
- Corn oil
- Sunflower oil
- Soybean oil

The high viscosity of oil can be reduced by using many methods like

- Dilution of vegetable oil
- Using microemulsion for non-edible vegetable oil
- Pyrolysis of non-edible vegetable oil to produce liquid fuel and biodiesel.
- Biodiesel from edible and non-edible vegetable oil through transesterification
- Non catalytic transesterification methods

The use of vegetable oil as alternative as a renewable resource for production of biodiesel has its many advantages.

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The major advantage of using oil as alternatives are: -

- Liquid nature portability
- Read availability
- Renewability
- Higher heat content
- Lower sulphur content
- Low aromatic content
- Renewable resources
- Easy availability
- Biodegradability, Cheap cost / non expensive

The disadvantage of using oil as alternative are:

- Higher viscosity
- Low volatility
- The reactivity of unsaturated hydrocarbon chain

The use of vegetable oil and their derivatives as alternative biodiesel oil
The direct use of oil in engine can cause a major problem like

- Because to the higher viscosity
- They also have a low volatility, which means they don't entirely burn.
- In a diesel engine, create a layer and deposit it at the injector.

The different method can be used for lowering the viscosity of vegetable oil by

- Microemulsion
- Alkanes, alkenes, carboxylic acid, and aromatic compounds are produced via thermal breakdown.
- Alkanes, cycloalkanes, and alkylbenzenes are produced through catalytic cracking.
- Transesterification process of ethanol and methanol

A. Biodiesel as an Alternative for Fuel

It's a clear yellowish liquid with the same viscosity as pd. [8] It is non-flammable and non-explosive when compared to pd, with a flash point of 423 k for biodiesel compared to 337 k for petrol diesel.[2] Biodiesel is also biodegradable, non-toxic, and minimises toxic and other emissions when used as a fuel. The cost of biodiesel is higher than that of gasoline diesel.[4] Right now, the production of vegetables oils and animal fats is that much as compare for the production of biofuels and cannot be replaced. as it states that biodiesel is best alternative for renewable resources from waste cooking and can be result out to be great result. the preparation of biodiesel can be done by two process that is transesterification and microemulsion method.

II. MATERIAL AND METHODS

A. Transesterification

In the present of catalyst, it is a chemical interaction between triglyceride and an alcohol (methanol). It is a three-step process in which triglycerides are transformed to diglycerides, then diglycerides are turned to monoglycerides, and finally monoglycerides are converted to glycerol. The transesterification reaction is a reversible reaction in which the reactants – fatty acids, alcohol, and catalyst – are mixed together. As a catalyst, a strong basic or acid might be utilized. Raw biodiesel and raw glycerol are the end products of the transesterification process.[5]

1) Advantage of Transesterification

- The condition of reaction can be easily controlled.
- large-scale manufacturing.
- The cost of the procedure is low.
- The methanol generated during the procedure can be reused.
- High production conversion rate

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B. Microemulsion

Microemulsion is a clear, [1] thermodynamically stable Isotropic liquid mixture of oil, water and surfactant, frequently in combination with a co surfactant. therefore, they don't require high inputs of energy or shear conditions for their formation. no direct oil \ water contact at the interface. [6]

The characterization of microemulsion

- It is transparent solution
- Isotropic
- Face is continuously and spontaneously fluctuating
- Relatively and low commercially cost

1) Advantage of Microemulsion

- Increase the rate of absorption.
- Increase bioavailability.
- Less amount of energy requirement.
- Efficient in room temperature.
- Less process times

This chapter list the materials used, the detailed experimental procedure used an do the analytical technique used for production of biodiesel from waste cooking oil using different surfactant and catalyst.

Chemical Name	Company Name	Manufacturing Date	Purity
Sodium Carbonate	Simson S	April 2021	99.5%
Sulphuric Acid	Simson	October 2019	99%
Sodium Sulphate	Oxford Lab Fine Chem Ltd	May 2019	99.5%
Methanol	Qualigens (Thermo Fisher Scientific India Pvt Ltd)	March 2021	99.5%
Ethanol			

Table 2: Chemical Name and Their Manufacturing Details

Conical Flask	Glass Rod
Beaker	Thermometer
Measuring Cylindrical Tube	

Table 3: Glassware

Magnetic Stirrer	Reflux Condenser
Separating Funnel	Filter Paper

Table 4: Other Requirements

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C. Methods

1) *Preparation of Biodiesel using Microemulsion Process:* For this process the waste cooking oil was collected from various streets vendors and stored in closed container. the oil was filtered several time using filter papers to remove the impurities and dust and solid particles and then sample was kept for 72 hours for better settlement, after 72 hours once again oil was filtered after this anhydrous NaSo4 was added in oil which works as water absorber and will settled down after the completion of process.[9]



Fig 2: filtration of waste cooking oil using Filter paper

The microemulsion was made by mixing equal parts butanol and ethanol with waste cooking oil in a 25 ml beaker at room temperature. A magnetic stirrer was used to keep a mixture of waste frying oil, butanol, and ethanol homogenous.

After the process is done the mixture is kept in glass bottle at room temperature. after this process the mixture was kept at room temperature for 24 hours which will help in forming two-layer, colour changes can be observed.

Here butanol will work as co- surfactant. The main reason behind using butanol as a co surfactant because it is suitable for hydrophilic – lipophilic balance for formulating desired microemulsion system. Mono-, di-glycerides, and free fatty acids are present it will help as surfactant in the formation of microemulsion. After the settlement of 24 hours, it can observe that two layers are formed.



Fig 3: the homogeneous Mixture



Fig 4: two layers is formed after 24 hours

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2) *Preparation of Biodiesel using Transesterification:* In this reaction one mole of triglyceride is reacted with three moles of alcohol to form one mole of glycerol and three mole of fatty acid alkyl ester. three reversible reactions where the triglycerides are converted to diglycerides and then monoglycerides. [4]

TRIGLYCERIDES + ALCOHOL ⟺ ESTER + GLYCEROL

Here, glycerol is formed as by product in this process, in response to the reaction A round sealed flask containing 100 ml of methanol and 2% wt. of sulphuric acid was filled with 100-150 ml of waste cooking oil. (Which is 98% as catalyst) putted on magnetic stirrer for forming homogeneous mixture for 30 mins (350 rpm) after this, mixture was kept in reflux condenser with oil bath maintained at 60 degree for 2 hours, temperature checked and maintained every minute. After the completion of process excess methanol which is used as a surfactant was recovered using rotary evaporated or separating funnel.

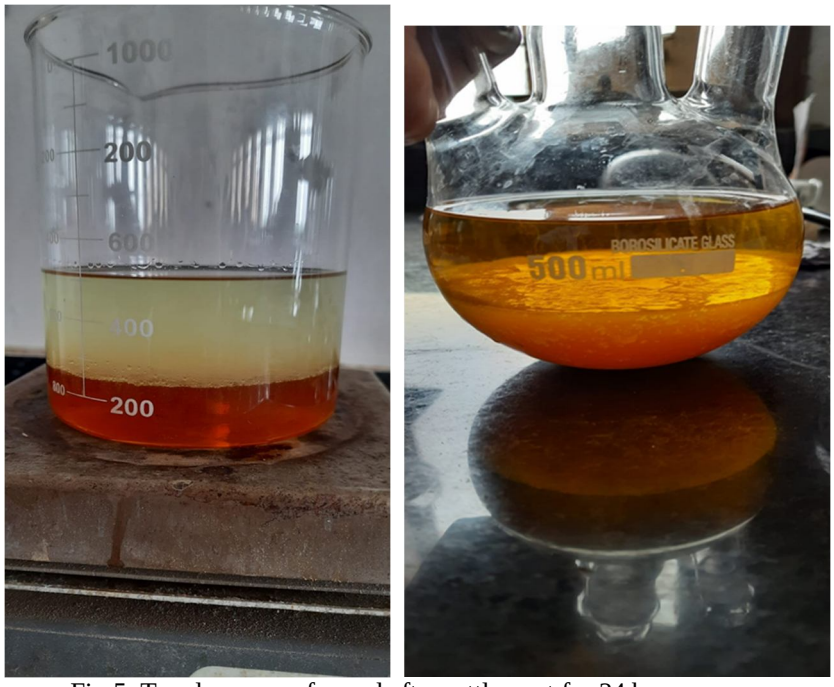


Fig 5: Two layers are formed after settlement for 24 hours


Fig 6: separated solution of glycerol and biodiesel of microemulsion solution

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The mixture of unreacted catalyst was neutralized with 1M NaHCO3solution (sodium carbonate) after this process the resulting mixture was dried in oven for 2 hours temperature maintained at 110 degrees. it can be noticed after three hours of process two layers are formed the upper layer is of biodiesel and lower is of glycerol

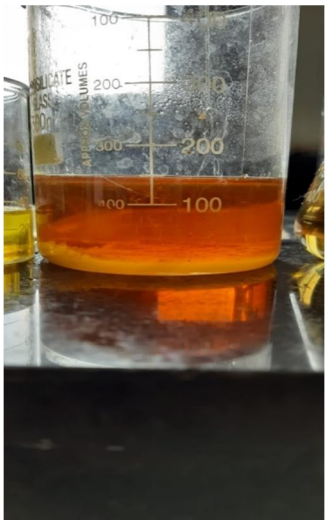
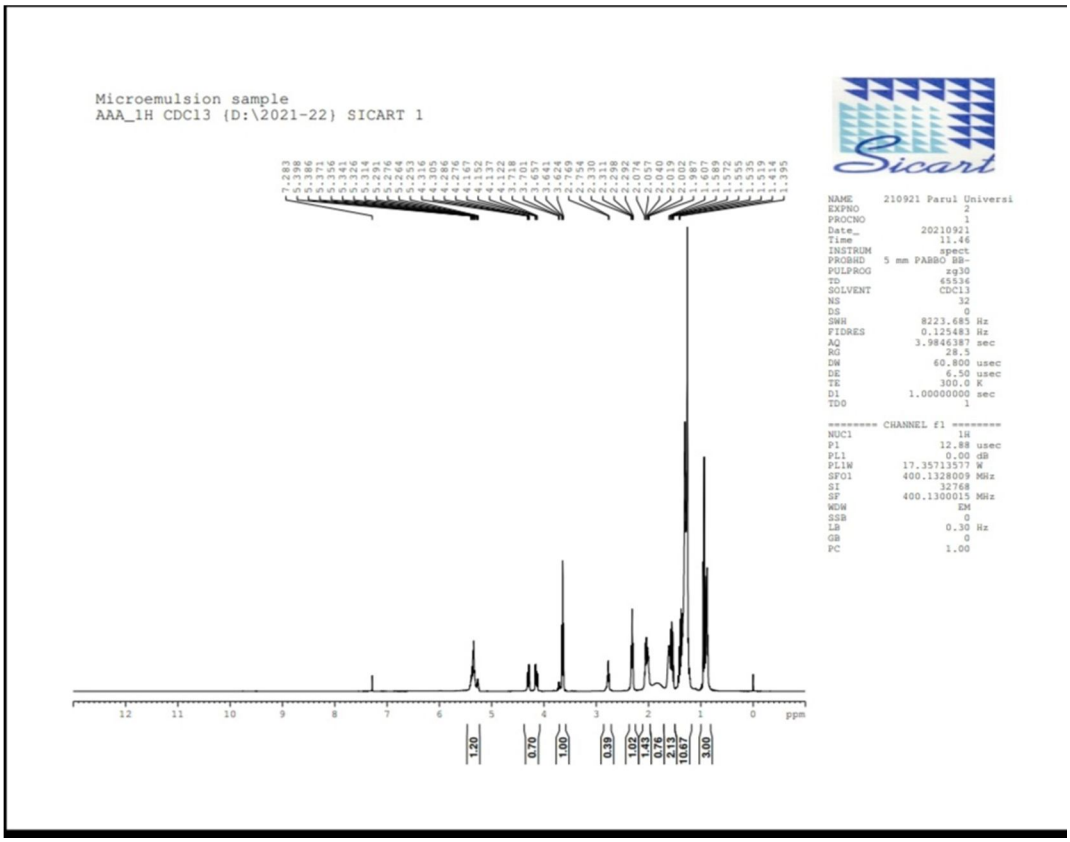


Fig 7: Transesterification mixture after heating

III.RESULT

As per the experimental process the amount of the solvent results out at a higher amount as compare to the biodiesel. This states that the equal balance proportion of waste cooking oil and surfactant play a major role in the production of biodiesel. The graph below states the purity of biodiesel and surfactant.

Fig 8: Sample A: 1H NMR of Microemulsion sample-based biofuel



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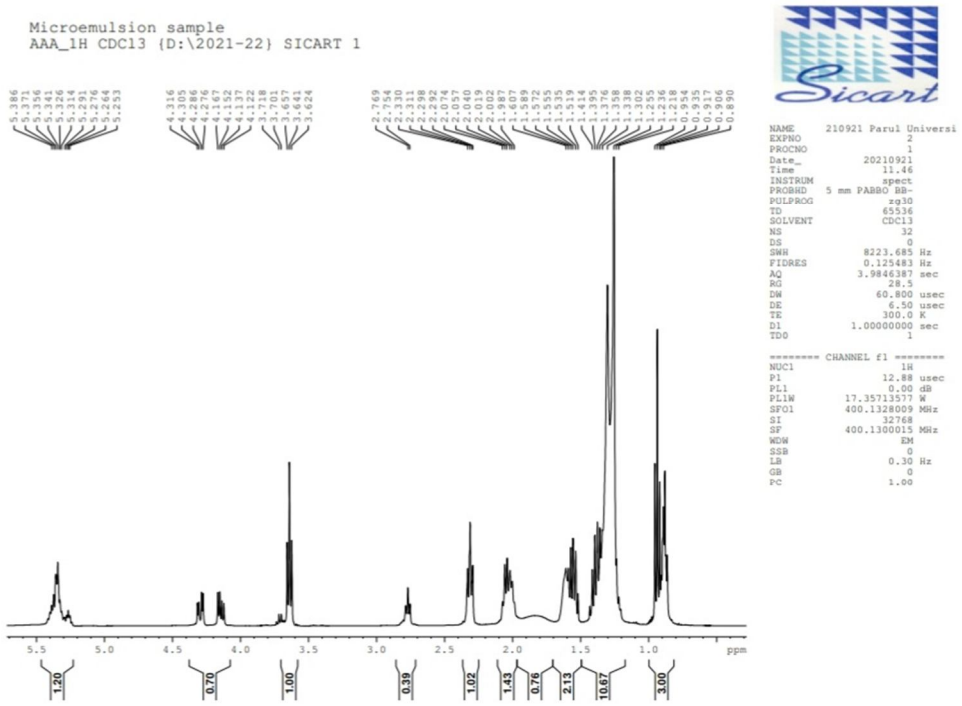
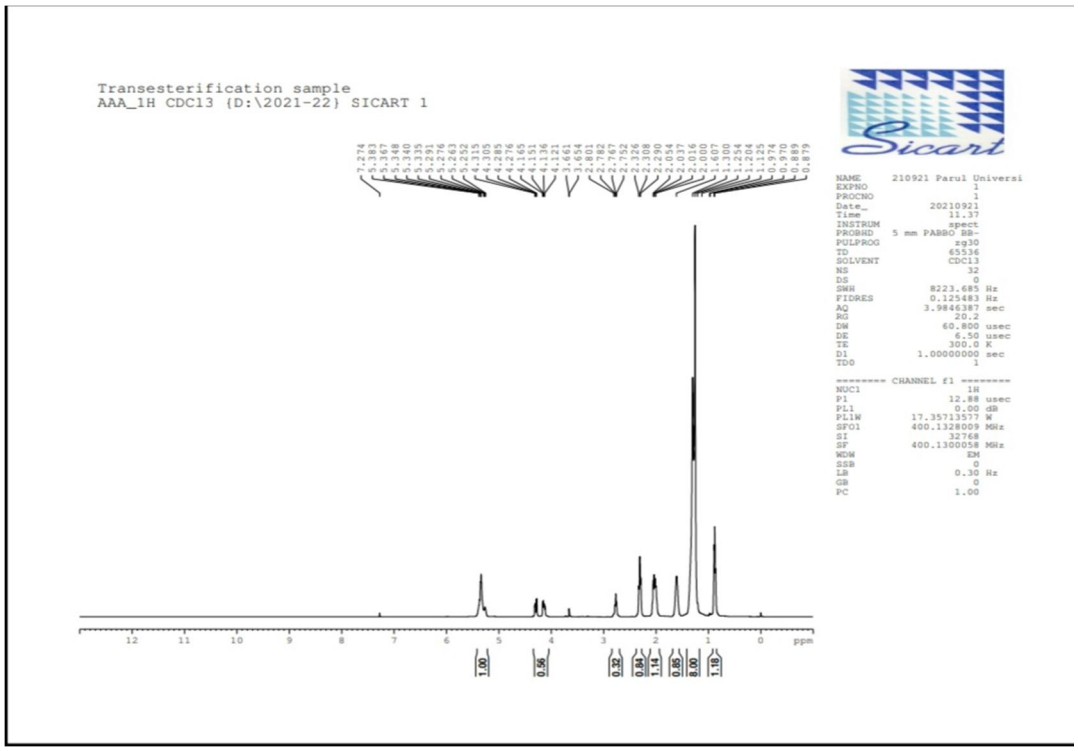
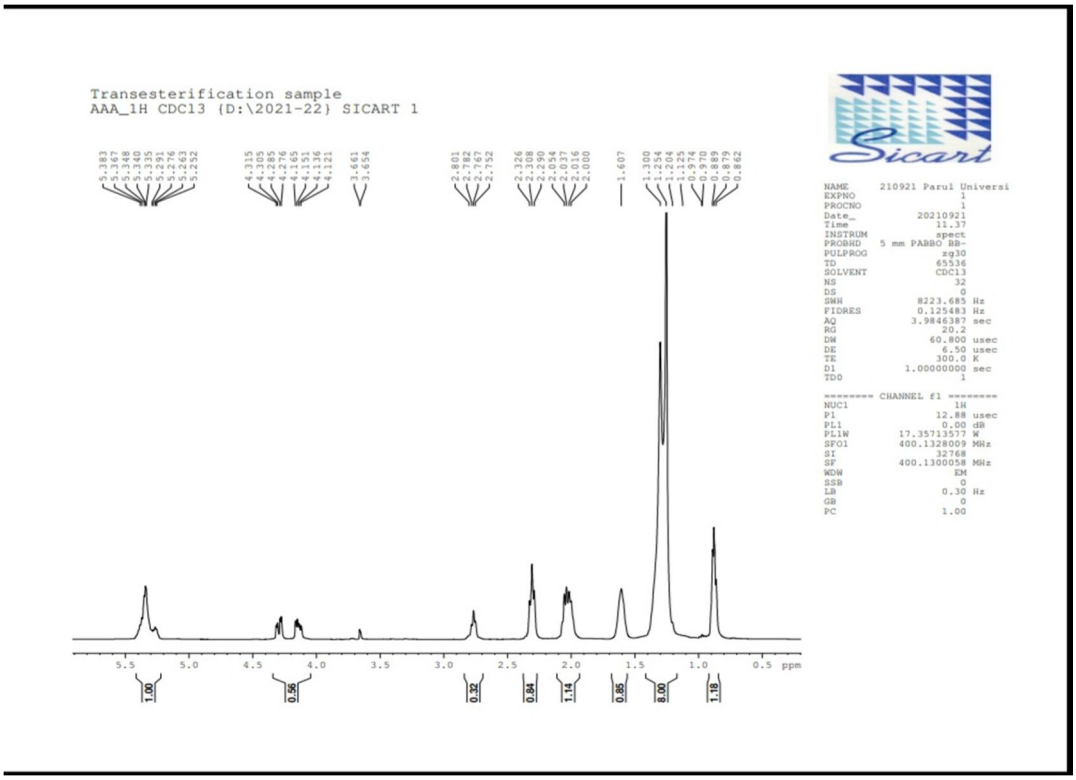


Fig 9: Sample B: 1H NMR of Transesterification sample



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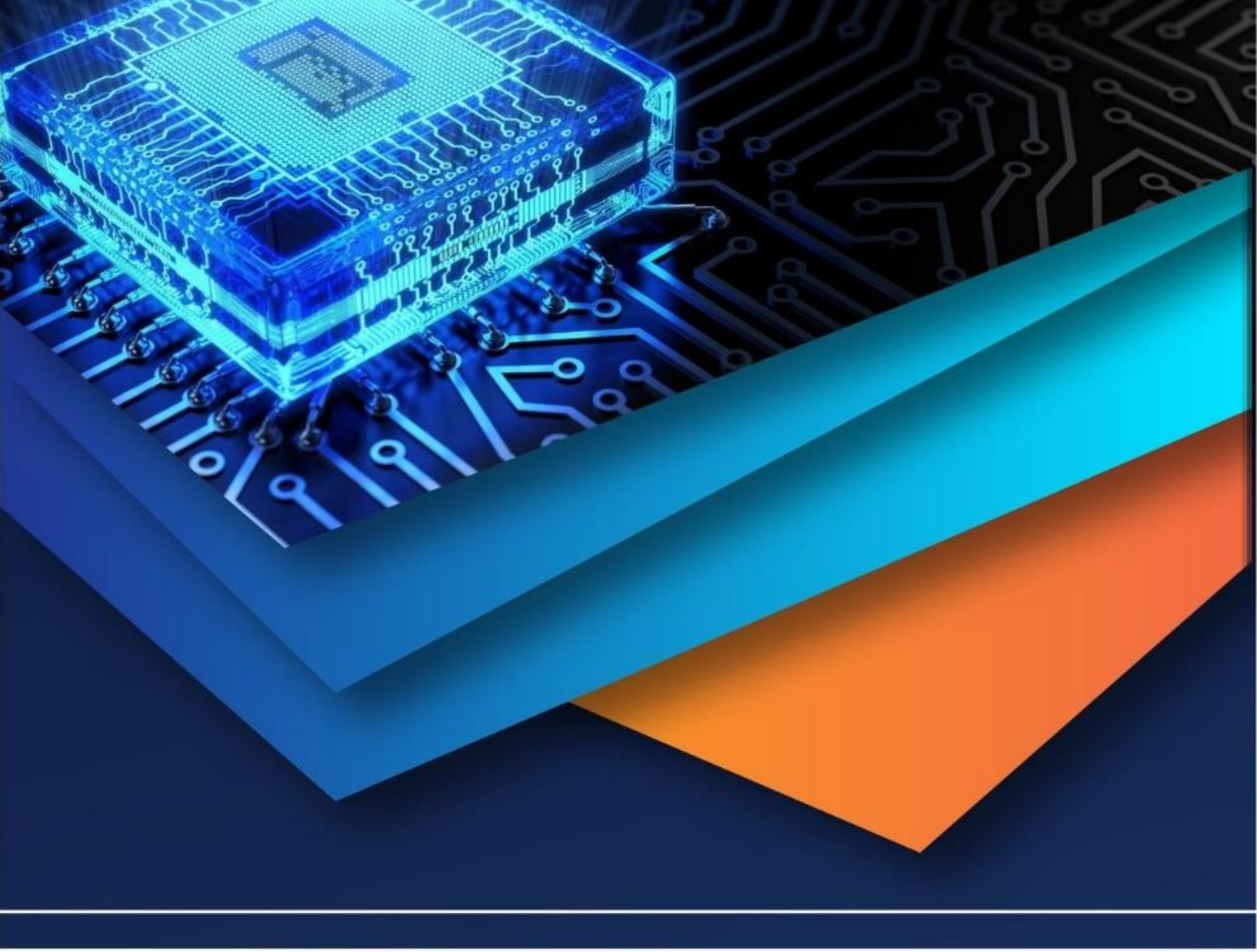
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