iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** X **Month of publication:** October 2019

DOI: http://doi.org/10.22214/ijraset.2019.10095

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 7 Issue X, Oct 2019- Available at www.ijraset.com

Performance Characteristics and Emissions Test on CI Engine using Biodiesel as Alternative Fuel

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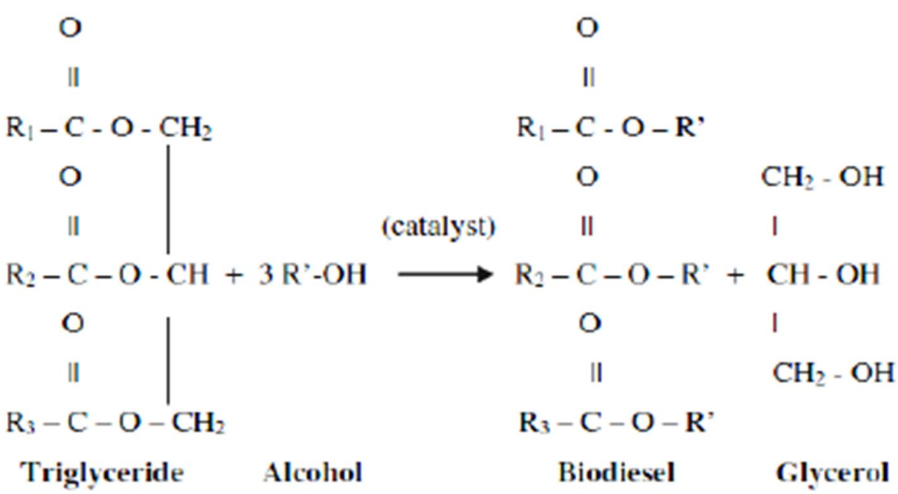
Abstract: The world is confronting the serious issue of consumption of convectional fuels. The availability fuel store will make sustainable power sources assets progressing more attractive. The most possible approach to satisfy this developing need is by utilizing alternative fuel fills. The production of biodiesel from Pongamia oils the properties of raw and their performance in diesel engine. Pongamia oil as biodiesel was tried for their exhibition in IC engine. The biodiesel used in this experiment have different blends like B10%, B20% and B30% and the impact of this biodiesel on diesel engine, performance and emission is investigated.
Keywords: Biodiesel, IC engine, Pongamia oil, transesterification, Performance and emission.

I. INTRODUCTION

In the present vitality condition crises, it got the way to perceive sustainable. Vegetable oils display an incredibly better choice to diesel oil, since they are sustainable, biodegradable and clean bursting, having properties practically identical to that of diesel. [1,4] It has been discovered that the tree species like Pongamia Pinnata ('Honge' or 'Karanja') and Jatropha, which would be astoundingly appropriate for oil extraction in our Indian conditions. Pongamia Pinnata is one of the forested areas based tree-borne non-acceptable oil with an age ability of 135,000 metric tons for consistently in India. [2,5,7]It is one of just a bunch couple of nitrogen fixing trees (NFTs), which convey seeds containing 30–40% oil. Various experts have driven assessments to ponder the execution and release traits of diesel engine when vegetable oils, blends of vegetable oil and its subordinates are used as fuel and it has been seen to be traditionalist and forceful appeared differently in relation to standard diesel. [3] Biodiesel is a fuel got from vegetable oils by adjusting their nuclear structure through a transesterification procedure. [6,8]Transesterification incorporates a reaction in a triglyceride and alcohol in region of a force to convey glycerol and ester.

II. MATERIALS AND METHOD

Trans-esterification is a chemical reaction that means to substitute the methanol and sodium hydroxide (NaOH) with pongamia oil mix. The mix is warmed up to 60◦c in the container and cooled with atmospheric room temperature. From these procedures oil was changed over into biodiesel blend. After transesterfication forms the oil blend changed over into two distinct layers in the container. Because of this pongamia based bio-diesel isolated into high thickness and low thickness layers. By utilizing of refined water channel the low thickness mix from compartment. This procedure will accomplish for all the mix proportions.



Stoichiometric transesterification reactions

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The mechanical properties like density, absolute viscosity, kinematic viscosity, flash point, fire point and calorific value of Pongamia biodiesel is determined by using different equipments like Bomb calorimeter, pensky apparatus and redwood viscometer according to Indian standards (IS) method.

Table-1: Comparison of properties of Pongamia oil with diesel

Oil/Properties	DENSITY (Kg/m^3)	KINEMATIC VISCOSITY (Cst)	FLASH POINT (0C)	FIRE POINT (0 C)	CALORIFIC VALUE (KJ/kg.k)
Diesel	830	2.95	48	58	45500
Pongamia Oil	875	3.10	173	191	36576
90D:10B	839	0.401	54	62	45470
80D:20B	848	0.893	56	96	44840
70D:30B	859	1.369	60	73	44210

III. EXPERIMENTAL SETUP

The experiment is conducted on four stroke single cylinder compression ignition (CI) engine with water cooling arrangement. The load is given to the engine with electrical brake dynamometer.

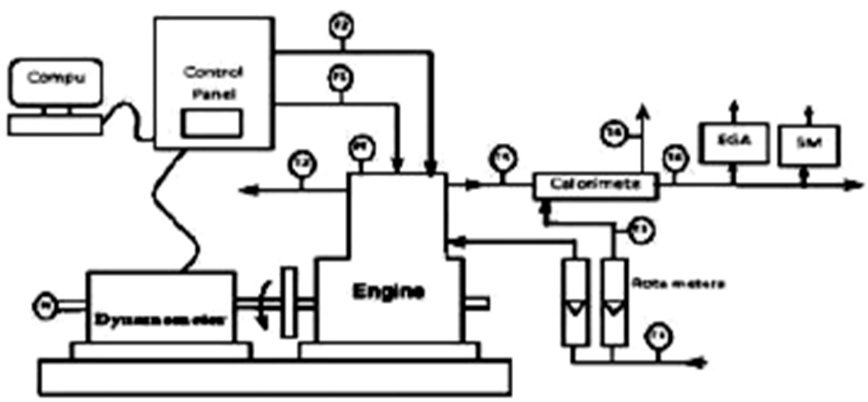

Fig 1: Line diagram of Experimental setup

Engine Specification

Acceleration due to gravity (g)	9.81 m/sec^2
Co-efficient of discharge for orifice (C_d)	0.64
Specific heat of water (C_p)	4.186 KJ/Kg^0 C
Density of water	1000 Kg/m^3
Density of air	1.21 Kg/m^3
Diameter of orifice (d_o)	0.014 m
Diameter of Piston (D)	0.08 m
Stroke length of Piston (L)	0.11 m
Number of cylinder (N_c)	1
Number of cycles (n)	2

Notations

PT	Pressure transducer
N	Rotary encoder
Wt	Weight
F1	Fuel flow
F2	Air flow
F3	Jacket water flow
F4	Calorimeter water flow
T1	Jacket water inlet temperature
T2	Jacket water outlet temperature
T3	Calorimeter water inlet temperatur = T1
T4	Calorimeter water outlet temperatu
T5	Exhaust gas to calorimeter temperature
T6	Exhaust gas from calorimeter temperature

IV. RESULTS AND DISCUSSION

Performance characteristics and engine emissions by using biodiesel of different blends are carried out under different loading conditions and the results are listed below.

A. Brake Thermal Efficiency(BTE)

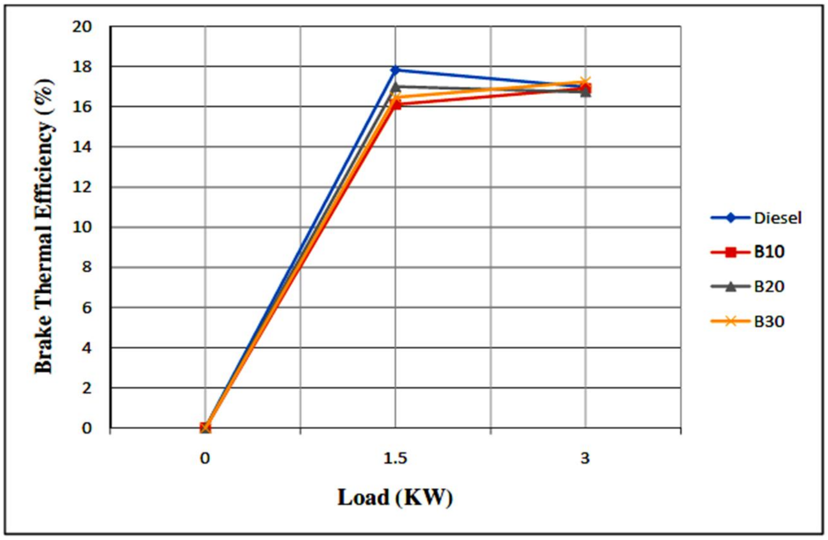

Fig 2: Brake thermal efficiency versus Load

The above graph represents the variation of brake thermal efficiency with variation in loads of different fuels i.e., Diesel, B10, B20, B30. It is seen that brake thermal is high for diesel at 1.5KW load. It is followed by B20. At 3 KW load, the brake thermal efficiency is high for B30 blend.

B. Specific Fuel Consumption (SFC)

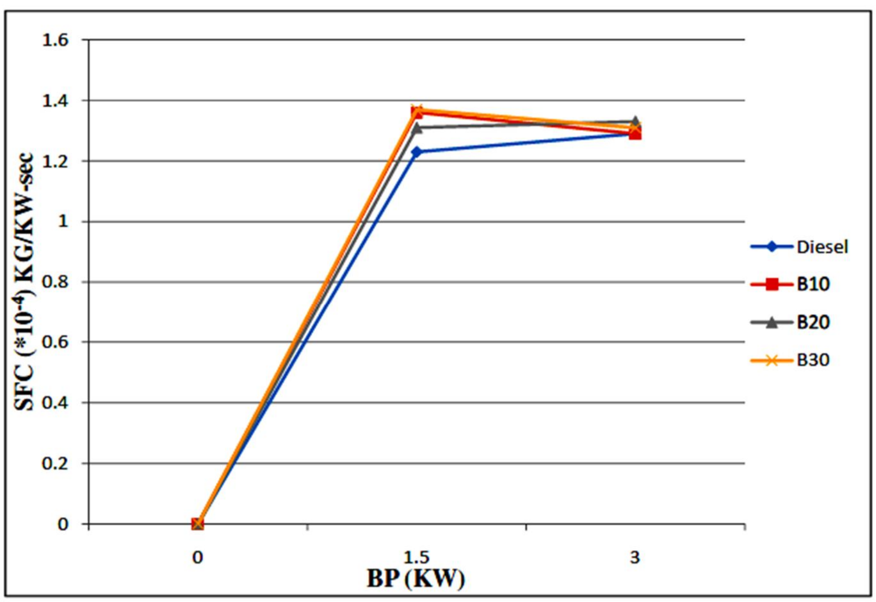

Fig 3: Specific Fuel Consumption versus Brake Power

The variation of Specific fuel consumption with the change in the load is shown in graph. It is seen that at no load condition all the fuels are at zero. For 1.5 KW load, the specific fuel consumption value is high for B30. At 3 KW load, the specific fuel consumption is more for B20 blend. At 1.5KW load, the specific fuel consumption of B30 biodiesel is 8.9% more that of diesel.

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C. Volumetric Efficiency

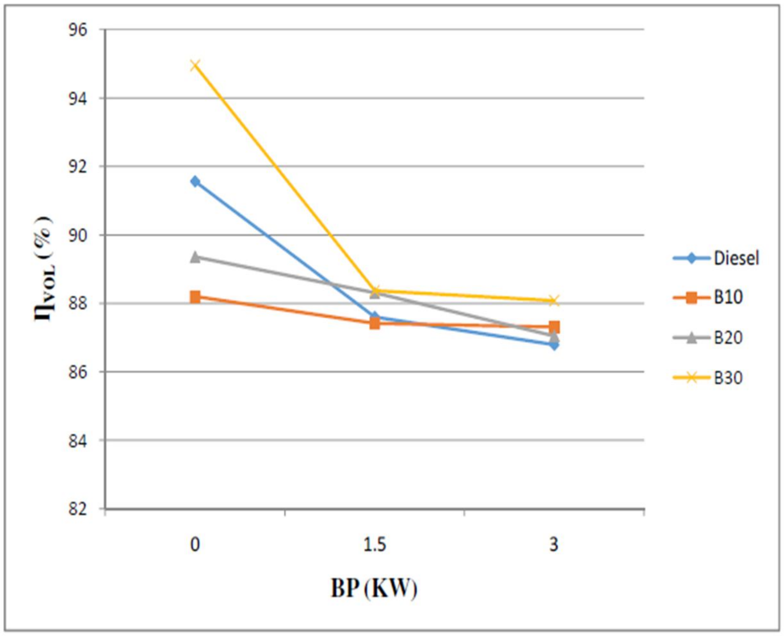

Fig 4: Volumetric efficiency versus Brake Power

The variation of volumetric efficiency with the change in the loads for different fuels is shown in the graph. It is seen that for all the three loads, volumetric efficiency is more for B30 blend. The volumetric efficiency of the diesel goes on decreasing with increase in the load and has the lowest volumetric efficiency at 3 KW load when compared with different fuels. At 0KW load, volumetric efficiency of B30 biodiesel is 1.4% more that of diesel volumetric efficiency.

D. Percentage of Nitrogen Emission for Different Blends of Biodiesel

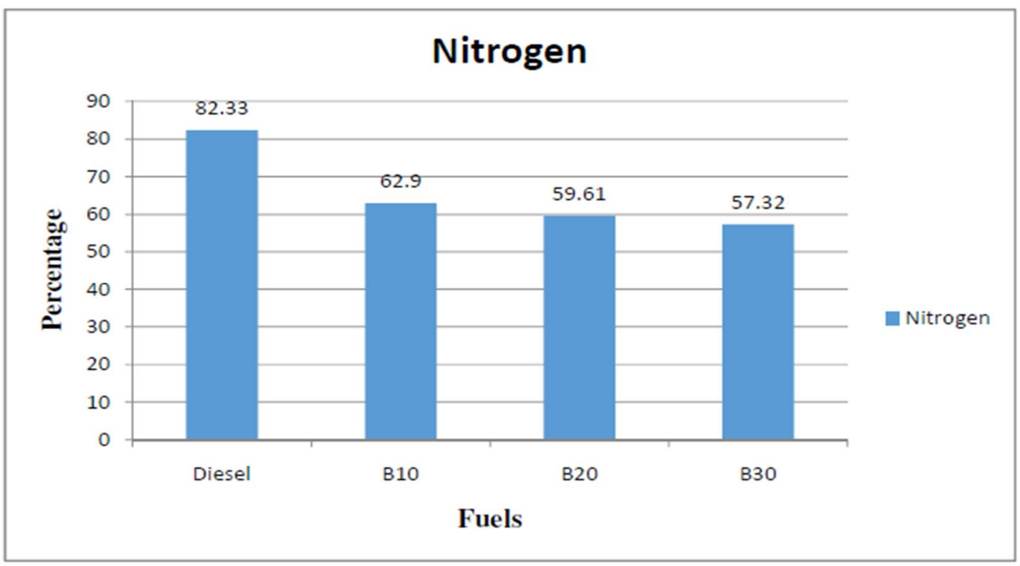

Fig 5: Percentage of Nitrogen emission

The amount of nitrogen gas released from exhaust with variation in the fuel or blends is shown in the graph. It is clearly seen from the graph that diesel fuel releases more nitrogen compared with other fuels. B30 blend releases less nitrogen. The emission of nitrogen goes on decreasing from diesel to B30. The more amount of nitrogen may lead to formation of nitrogen oxides by reacting with oxygen at higher temperatures.

E. Percentage of CO,CO_2 and O_2 emission for Different Blends of Biodiesel

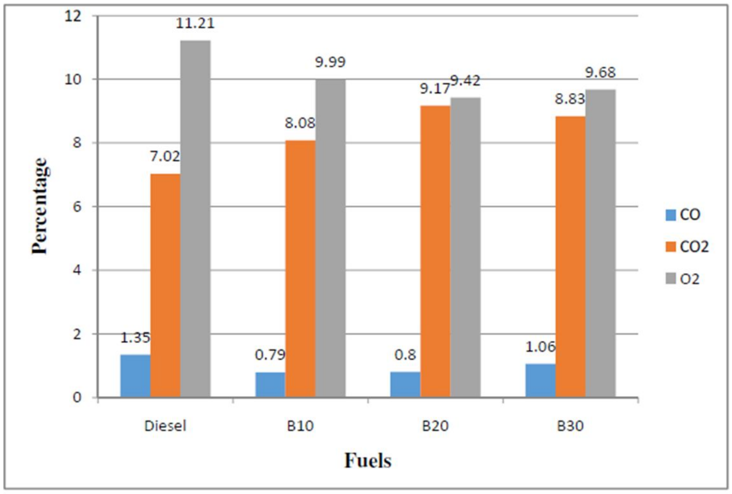

Fig 6: Percentage of CO, CO_2 and O_2 emission

The graph represents the percentage of exhaust gases (CO, CO_2 and O_2) released with the variation of fuels at peak load (3KW load).

1) *CO Emissions:* These are high in case of Diesel and B30 when compared to B10, B20. CO is released due to incomplete combustion. These emissions may cause serious respiratory problems with continuous exposure to it.
2) *CO_2 Emissions:* It is observed that these emissions are high in case of B20. The CO_2 Emissions goes on increasing from Diesel to B30. More CO_2 emissions can lead to global warming.
3) *O_2 Emissions:* It is seen that the O_2 emissions is more for B30 blend. The O_2 Emissions for B10, B20 are exactly half to that of B30.

F. Percentage of Hydrocarbons (HC), NO_X (PPM) emission for different blends of biodiesel:

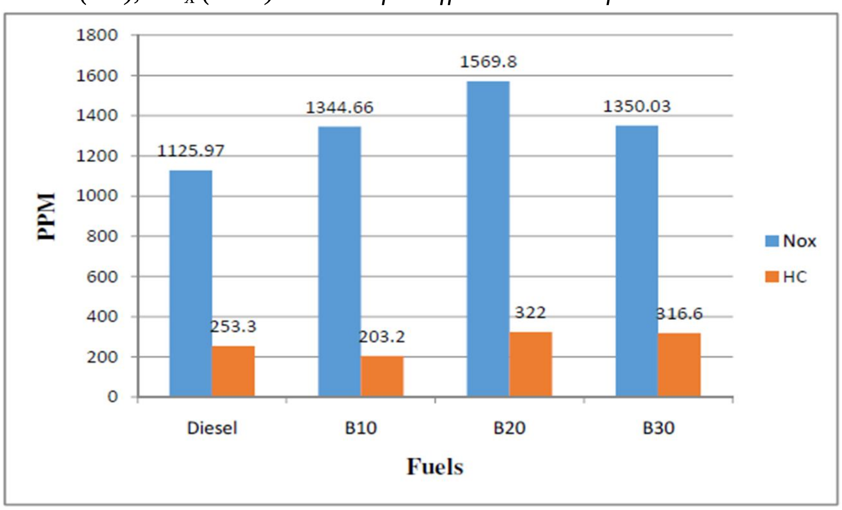

Fig 7: Percentage of Hydrocarbons (HC), NO_X (PPM) emission

NOX Emissions: Nitrogen oxides emissions are maximum for B20 blend biodiesel. The minimum amount of emissions is for diesel. Generally, NOx is produced during moderate to heavy load conditions when combustion pressures and temperatures are the highest.

Hydrocarbons: The least amount of hydrocarbons is produced for B10 blend biodiesel. In B20blend, highest number of HC is released. Hydrocarbons are raw unburned fuel and are caused due to fault in design of combustion chamber and deposits of carbon on the walls of the combustion chamber.

V. CONCLUSION

From the experiment it is concluded that Diesel engine can perform satisfactorily with Pongamia oil methyl esters and their different blends without any engine modifications. CO, nitrogen and smoke emissions for all biodiesel blends will gradually decrease when compared to diesel. The combustion analysis showed that the biodiesel added to the conventional diesel fuel decreased the delay period and lowered the heat release rate of the premixed combustion. However, SFC increases with increase in percentage of biodiesel in the biodiesel blends because of the lower heating value of biodiesel. Thus, results indicate that Pongamia oil methyl ester can be used as an alternative and environment friendly fuel for a diesel engine.

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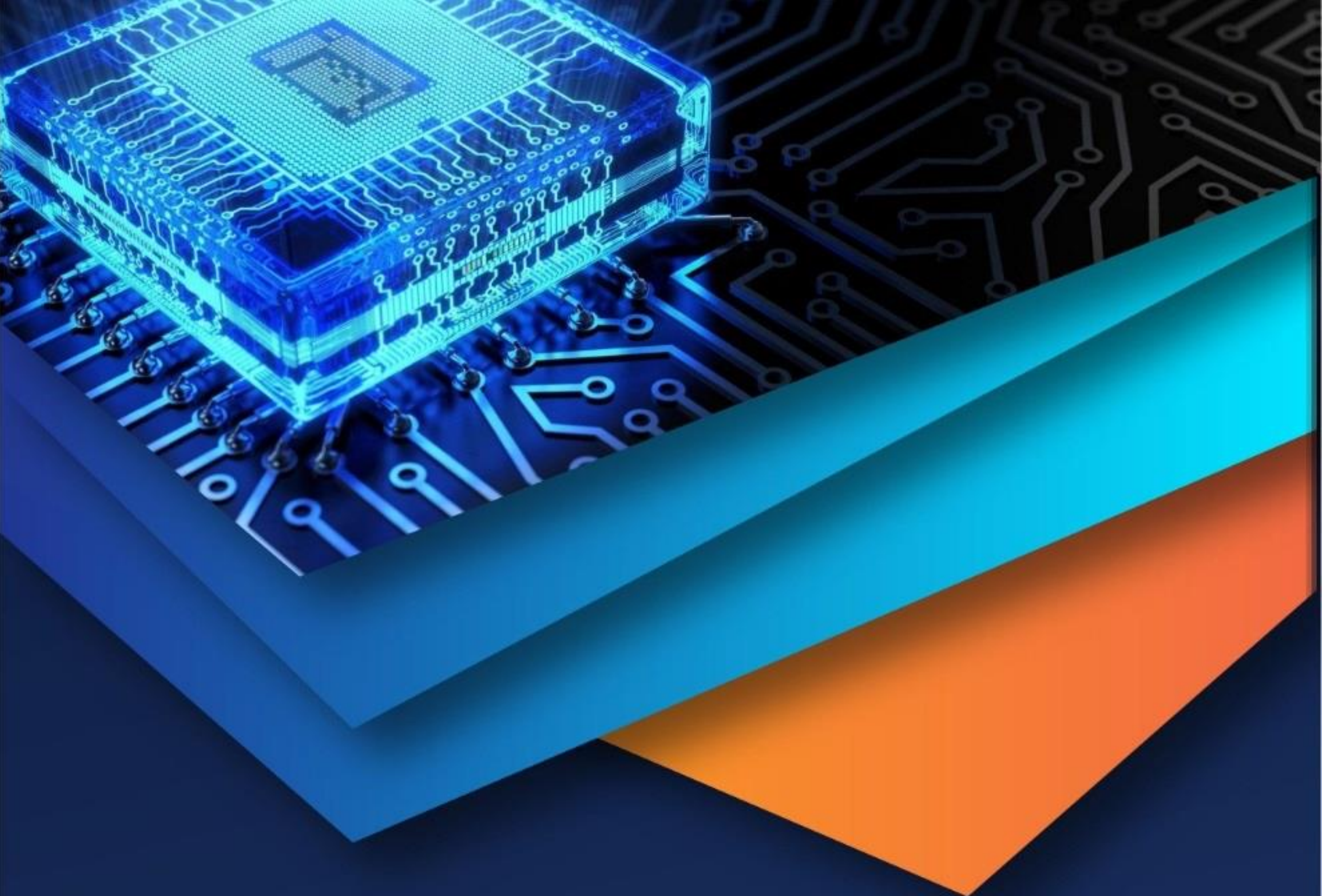

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