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Study of Natural Convection around a Radial Heat Sink with Curved Plate Fins

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Abstract: ***This paper presents the details of an experimental and numerical investigation of natural convection in a radial heat sink, composed of a horizontal circular base and curved fins mounted on it and flux input will be examined. Using the experimental data and some basic simulation we will validate our model . The general flow pattern is that of chimney; i.e., cooler air entering from outside is heated as it passes between the fins, then rises from the inner region of heat sink. Parametric studies will be performed to compare the effects of on two parametric geometric (no. of fins and height of fins). This is a crucial aspect in what concerns the expected lifetime of the LED lamp and should be achieved at the expense of as low as possible aluminium mass. The objective is to achieve a maximum core temperature of 70 degree C keeping the heat sink total mass and occupied volume contained.***
Keywords: Curved fins, height of fins, radial heat sink, 70 degree C, experimental investigation.

I. INTRODUCTION

We experimentally investigate natural convection from Radial Plate Curved Plate Fins and Flux input will be examined. Using the experimental data and some basic CFD simulation we validated our model. We plotted a graph between Temperature variation vs number of fin. The graphs showed certain fin number at which the thermal resistance is minimized. We compared the temperature variation for curved fins of plate vs temperature variation on straight fins of plate. In addition to that we will also find out optimal value of fin number. This is a crucial aspect in what concerns the expected lifetime of the LED lamp and should be achieved at the expenses of as low as possible aluminum mass. Taking these criteria in mind, a design procedure is proposed and followed in the search for the improved heat sink to cool a particular LED lamp. The objective was to achieve a maximum core temperature of 70°C keeping the heat sink total mass and occupied volume contained. The presented methodology is general in character and may be extended to improve other types of heat sinks for virtually any other electronic components.

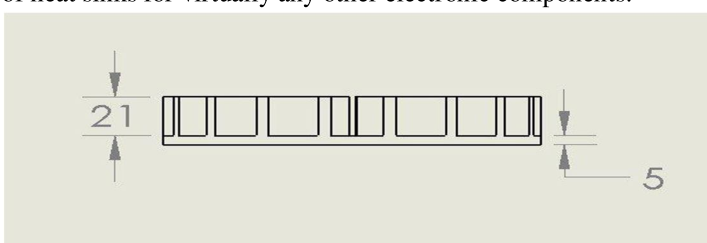

Fig 1: Front View of original Heat Sink
The above fig has dimensions as follows.
Height of the fins 21mm
Thickness of the plate on which fins are placed 5mm

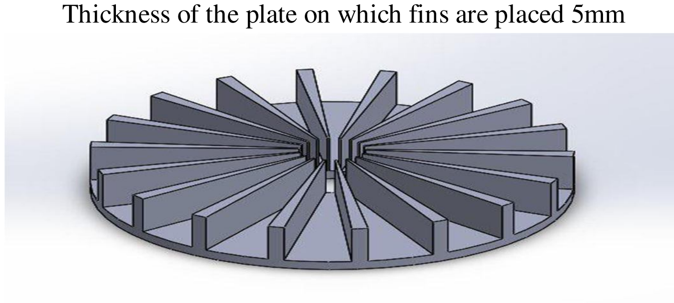

Fig 2: Isometric View of original Heat Sink
Following is the isometric view of the original heat sink which is currently use now a days which has straight fins

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A. Modified Heatsink

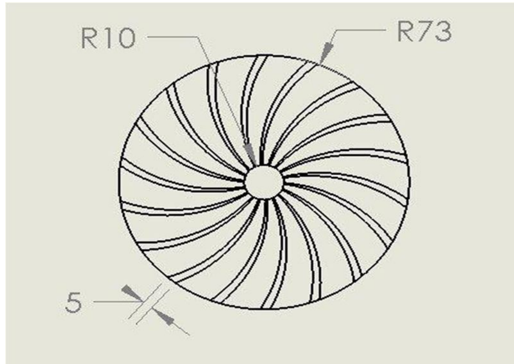

Fig 3: Top View of modified Heat Sink

Following is the fig which is modified fig in which fins are curved whose outer dimeter is 146mm and inner heat sink diameter is 20mm and the thickness of the fins is 5mm

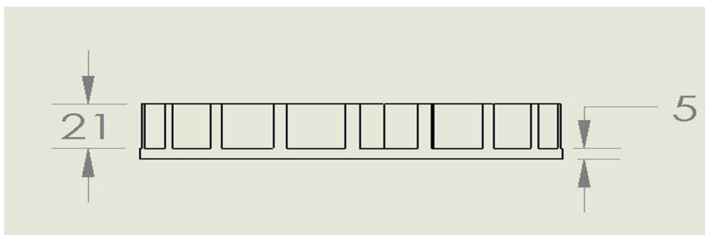

Fig 4: Front View of modified Heat Sink

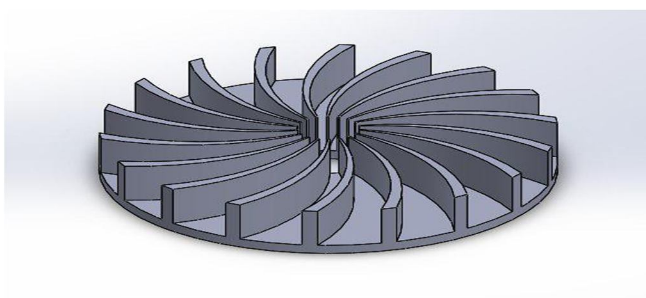

Fig 5: Isometric View of modified Heat Sink

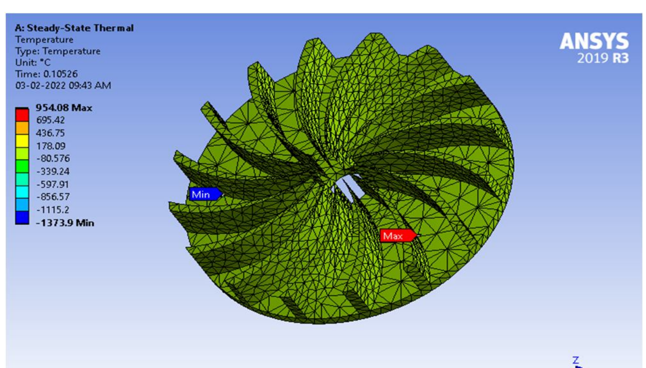

Fig. Heat sink with 16 fins

A Steady State Thermal Image of an ungenerated heat flux. This is the snapshot of 16 Fins Radial Heat Sink in Ansys software before the implementation of our analysis.

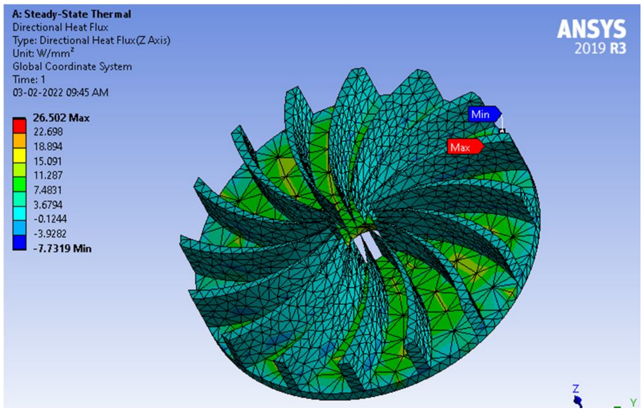

Fig. Analysis of 16 fins Heat sink

In this analysis, we achieved a minimum of 7.7 °C and a maximum of 26.5 °C on the Radial Heat Sink containing 16 number of fins.

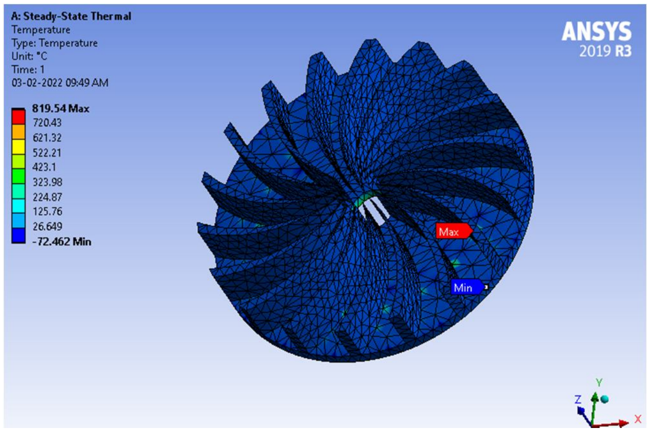

Fig. Heat sink with 18 fins

A Steady State Thermal Image of an ungenerated heat flux.This is the snapshot of 18 Fins Radial Heat Sink in Ansys software before the implementation of our analysis.

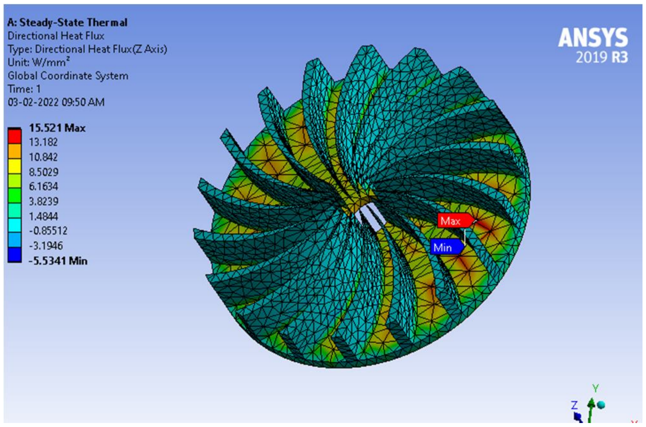

Fig. Analysis of 18 fins Heat sink

In this analysis, we achieved a minimum of 5.5 °C and a maximum of 15.5 °C on the Radial Heat Sink containing 18 number of fins.

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RESULT TABLE

NUMBER OF FINS	FLUX INPUT(W/M^2)	MAXIMUM TEMPERATURE(°C)	MINIMUM TEMPERATURE(°C)	AVERAGE
16	2000	69.20	67.76	68.48
17	2000	67.66	66.27	66.96
18	2000	53.21	51.88	52.54
19	2000	62.00	60.85	61.42
20	2000	64.00	62.76	63.38
22	2000	65.43	64.08	64.75

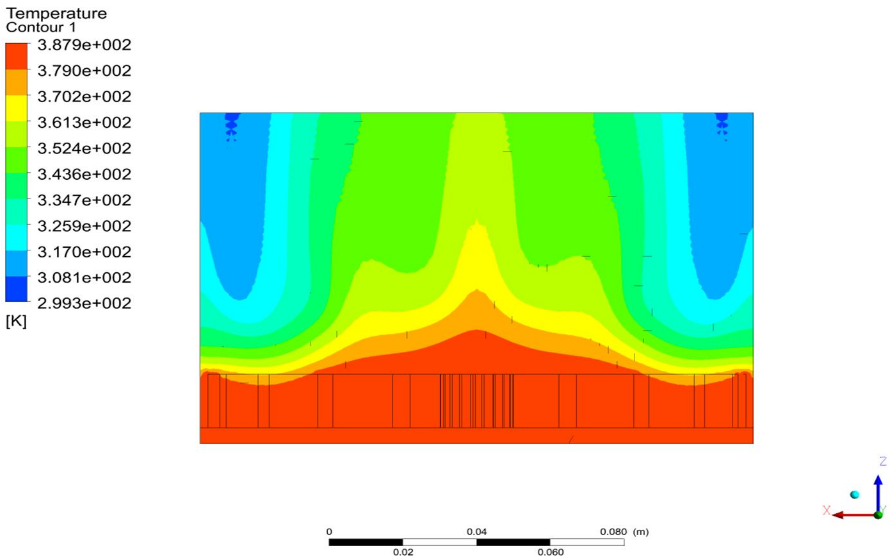

Figure : Simulation of heat sink with height=17mm

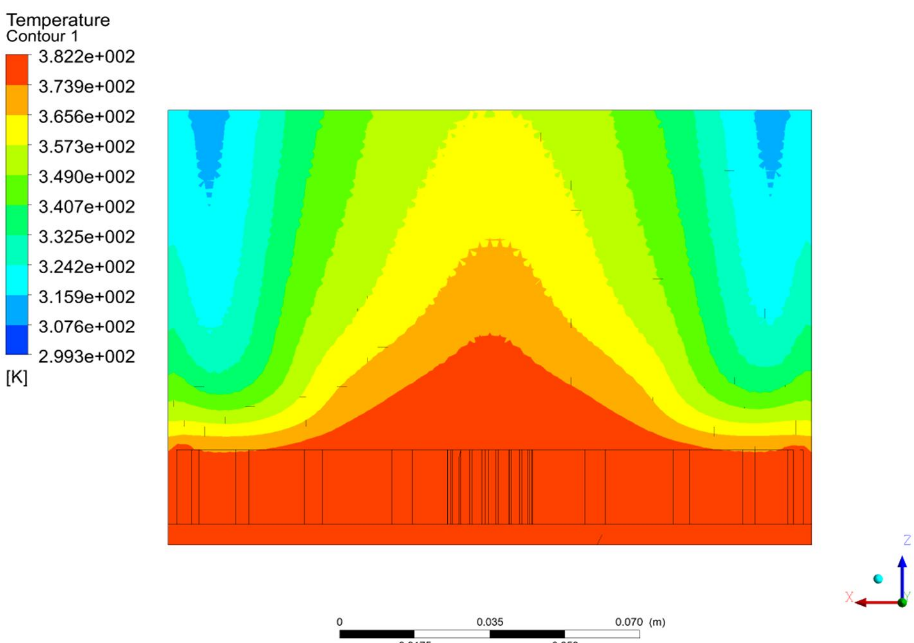

Figure : Simulation of heat sink with height=18mm

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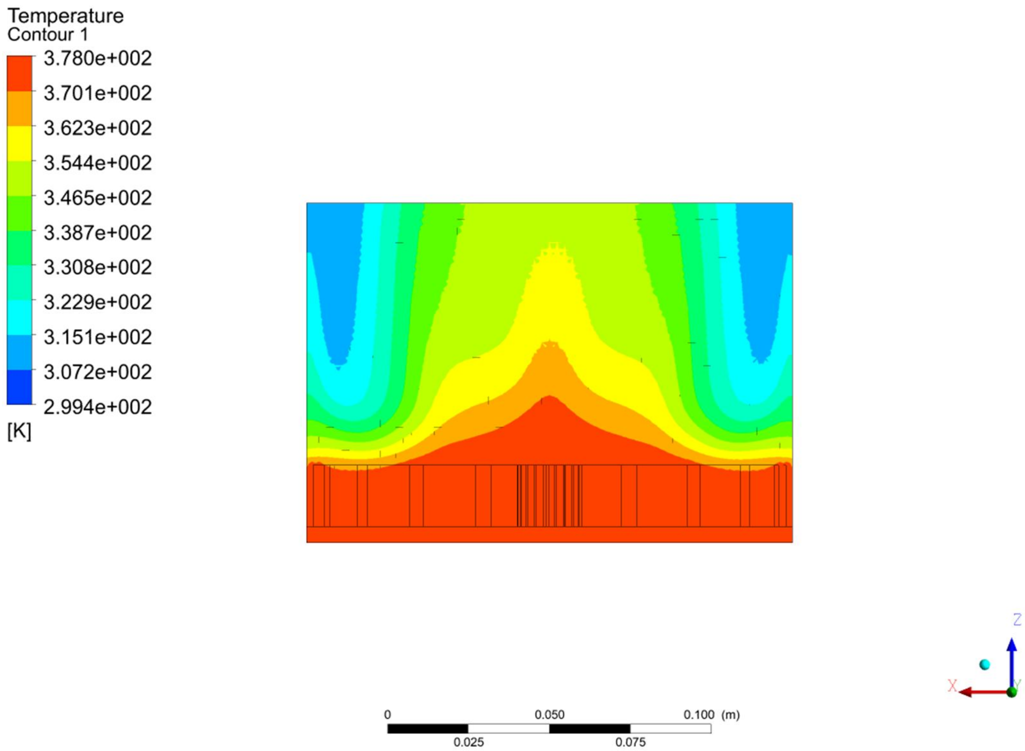

Figure : Simulation of heat sink with height=19mm

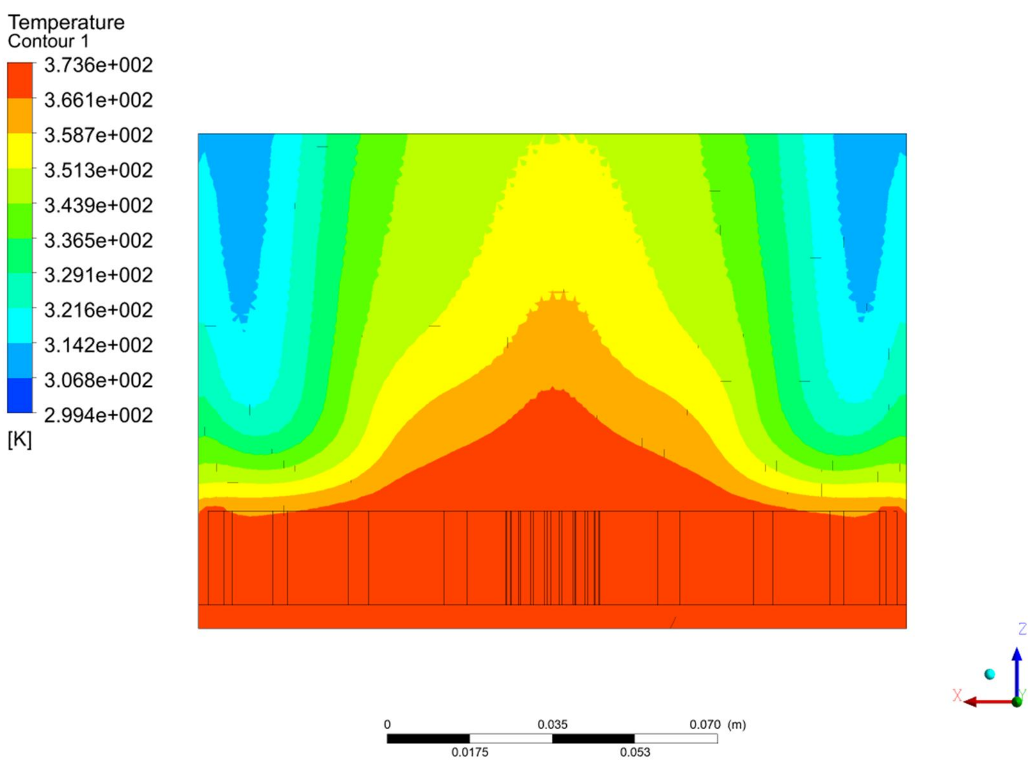

Figure : Simulation of heat sink with height=20mm

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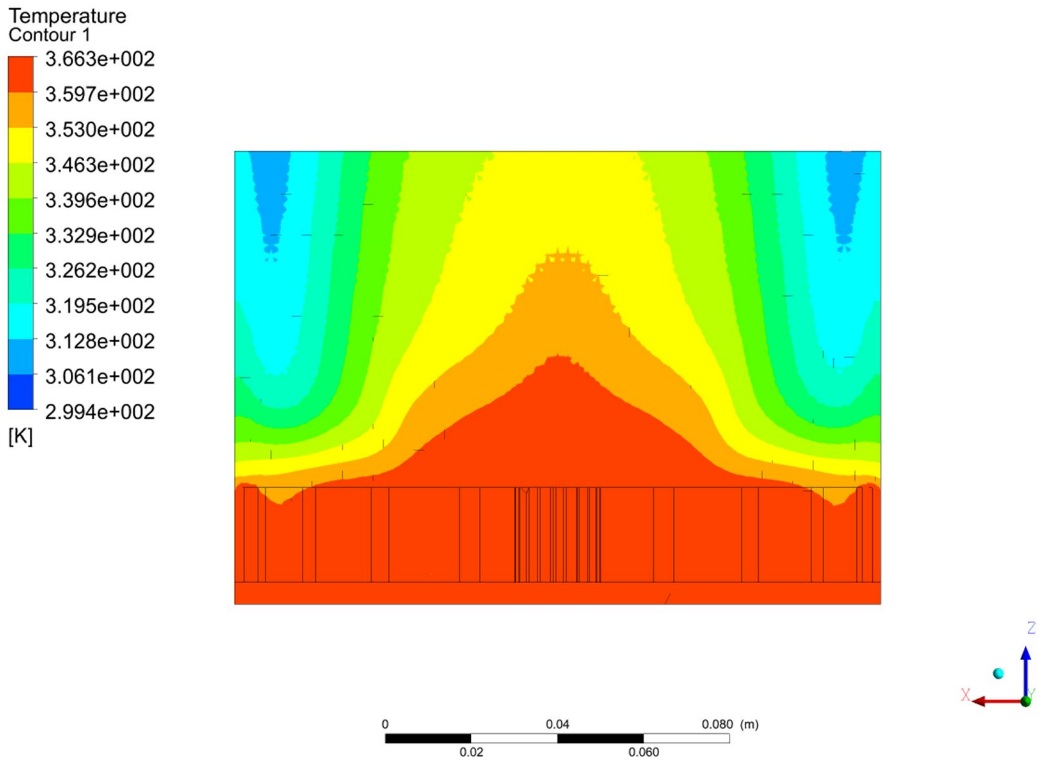

Figure : Simulation of heat sink with height=22mm

II. CONCLUSIONS

Parametric studies were performed to compare the effects of the number of fins, fin length, fin height, and heat flux on the thermal resistance and the heat transfer coefficient to applied for the street light.

As the number of fins, fin length, and fin height increased, the thermal resistance and heat transfer coefficient generally decreased and hence it is more conveninent to use for street light led working.

However, there existed optimal values of the number of fins and fin length to obtain an effective low heat sink temperature so that the heating of led is controlled.

III.ACKNOWLEDGMENT

We are profoundly grateful to Prof. Bhushan G. Patil for his expert guidance and continuous encouragement throughout to see that this project rights its target since its commencement to its completion.

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At last we must express our sincere heartfelt gratitude to all the staff members of Mechanical Engineering Department who helped us directly or indirectly during this course of work.

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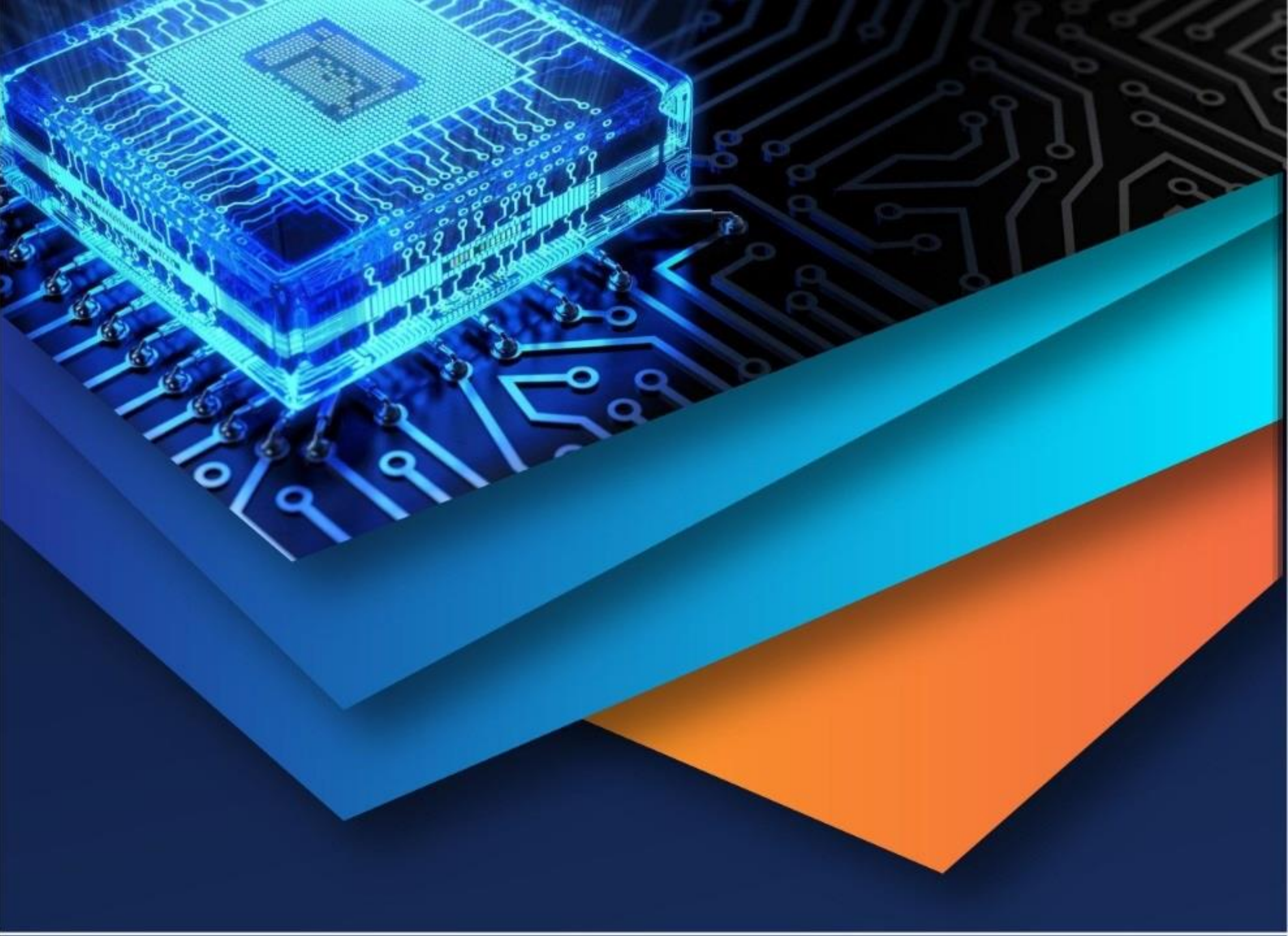

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