iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 4 **Issue:** V **Month of publication:** May 2016

DOI:

Volume 4 Issue V, May 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Model analysis of al-sic and cast iron 4 stroke single cylinder engine crankshaft

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***Abstract*—the crankshaft is the heart of the engine which converts the reciprocating motion of the piston in to the linear motion through the connecting rod. An attempt is made in this paper on single cylinder 4 stroke I.C engine crankshaft. The 3-D model of the crankshaft is made in modelling tool UNIGRAPHICX discretization of the component is made in HYPERMESH and analysis is done in ANSYS by applying the boundary conditions. In this paper 6 modes of Model analysis of Al-SiC and cast iron materials are done and frequency is derived separately and the maximum and minimum frequency of both the materials is concluded.**
***Keywords*: - Cast iron, Aluminium silicate, and ANSYS, UNIGRAPHICX, HYPERMESH, and Frequency model.**

I. INTRODUCTION

Crankshaft is the component which is place below the piston connected through the connecting rod which translates the reciprocating motion to the linear motion. The maximum load experience by the crankshaft from the piston through the connecting rod and due to this crankshaft has mode stress and vibration and may lead to damage. The crankshaft must be stronger to take force from the power stroke without extreme bending. During the conversion of reciprocating motion to the rotary motion crankshaft undergoes both vibrations and vertical loads. In this paper the frequency and the mode shape behaviour of the component made of Al-SiC and cast iron is studied. K Triveni and B.Jaya Chandraiah conducted Model analysis of single cylinder 4 stroke engine crankshaft on two case free frequencies case and frequency case in which boundary conditions are taken from the engine specifications In free-frequency case the resonance frequency is 1150.967Hz at 7th mode. The driving frequency is nearly 100Hz when the engine running at the high speed. As the lowest natural frequency is far higher than driving frequency, possibility of resonance is rare. In frequency case the minimum frequency occurred at 1st mode is 890.735Hz, the maximum frequency occurred at 10th node is 5539.023Hz.

II. OBJECTIVE

In this paper an attempt is made the crankshaft is designed in UNIGRAPHICX NX8 and model analysis of the crankshaft is done in ANSYS software. To evaluate the natural frequency of Al-SiC and Cast iron material with different case.

III. DESIGN METHODOLOGY

A. Initially part modelling of the two crankshaft(cast iron and Al-Sic) is made in UNIGRAPHICX NX8 tool and save the file in .IGES for analysis of crankshaft in ANSYS by importing.
B. Material application for crankshaft details
Material type 1: - Aluminium silicate (Al-Sic)
Poisson ratio: - 0.29
Yield strength:-500Mpa

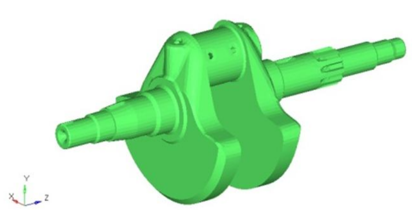

Fig 3.1 Al-Sic Crankshaft Model

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C. Material type 2: - Cast iron
Poisson ratio: - 0.26
Yield strength:-620Mpa

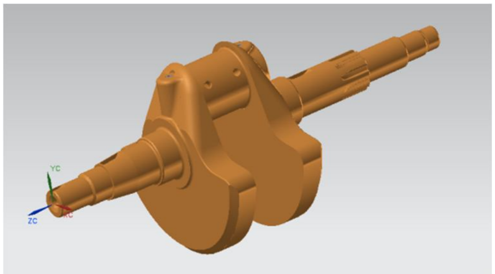

Fig 3.2 Cast iron Crankshaft Model

D. Meshing of crankshaft
Type of element: - Tetrahedron10.
Number of Nodes:-17338.
Number of Elements:-74045
The visual of the both the crankshafts fig 3.3and 3.4 are similar but of different materials.

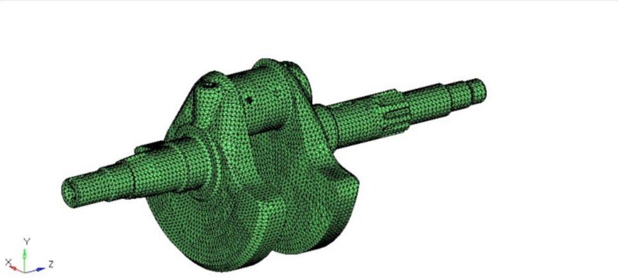

Fig 3.3 Meshed model of Al-Sic crankshaft

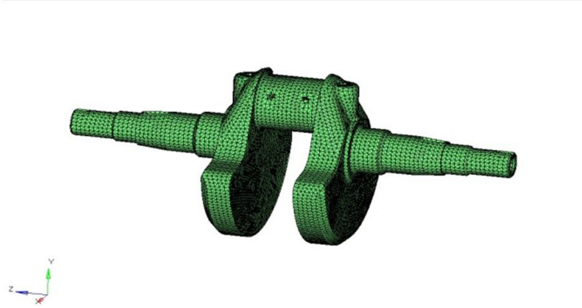

Fig 3.4 Meshed model of cast iron crankshaft

E. Boundary conditions for analysis
Boundary conditions play an important role in the part of analysis. Here we have taken the displacements for fixed bearing supports.

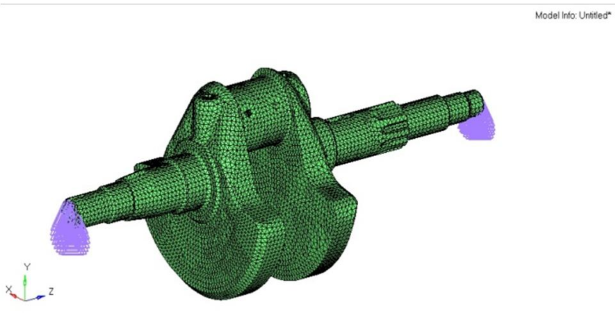

Fig 3.5 Fixed supports boundary conditions (Al-Sic)

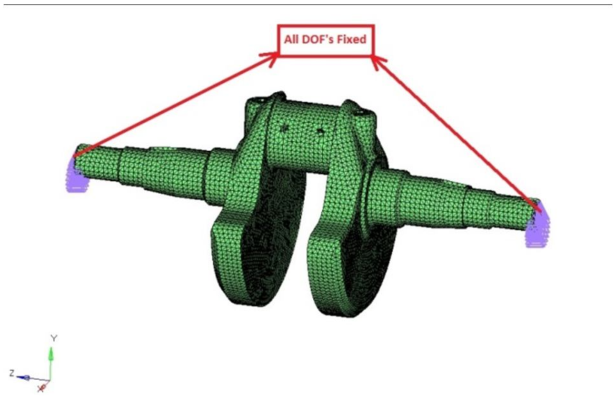

Fig 3.6 Fixed supports boundary conditions (Cast iron)

F. Analysis run and results
Case 1:- Frequency case of cast iron crankshaft
In frequency case the boundary conditions are applied on the crankpin area and 6 modes of vibrations are derived as shown in table

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01.

Model orders	1	2	3	4	5	6
Frequency in Hz	295.23	395.13	432.73	1164.4	1229.4	1671.1

Table 01:- Natural frequency case

1) First mode of vibration

The first mode of frequency appears maximum at the bottom of the crank web at natural frequency of 295.225

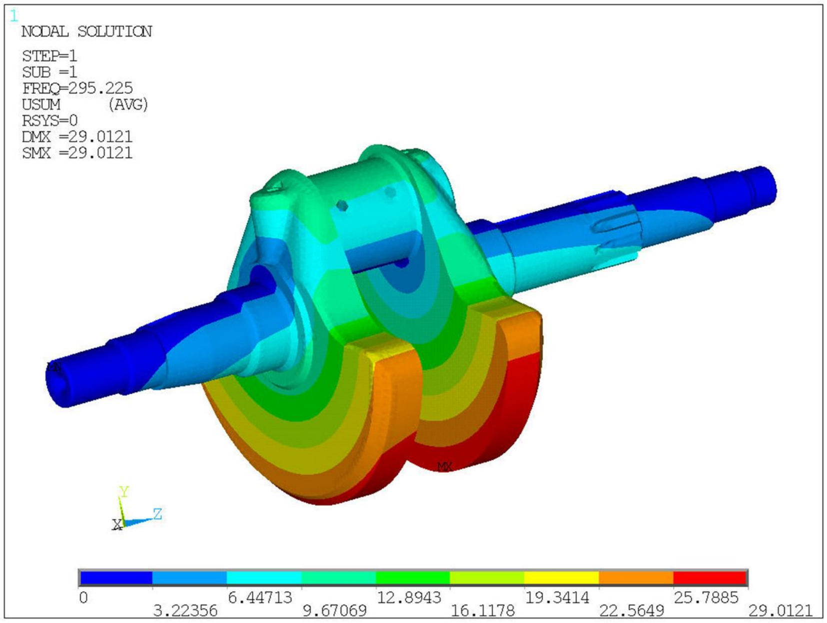

Fig 3.7 First vibration model of CI crankshaft.

2) Second mode of vibration

The second mode of frequency appears maximum at the fillet radius at natural frequency of 395.13

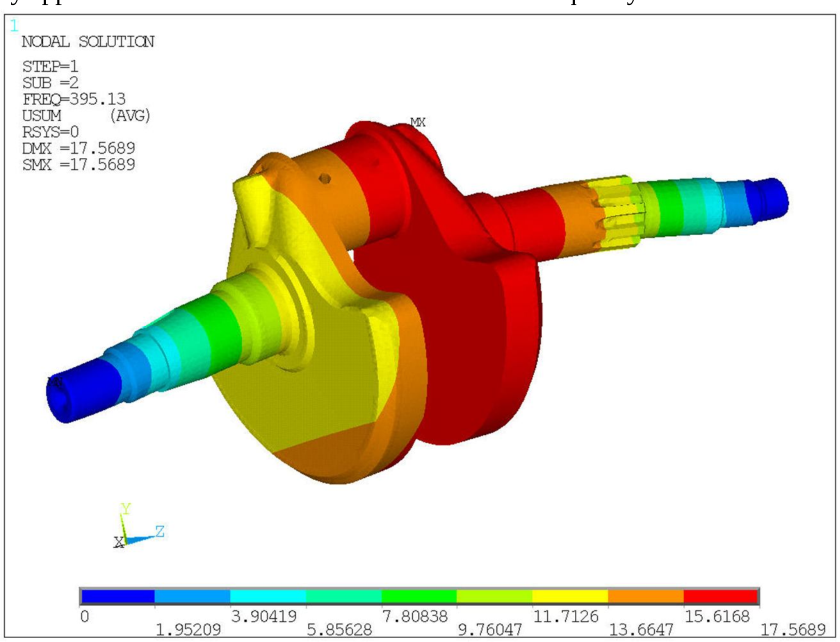

Fig 3.8 Second vibration model of CI crankshaft.

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3) Sixth mode of vibration

The sixth mode of frequency appears maximum at the left crank web at natural frequency of 1671.09

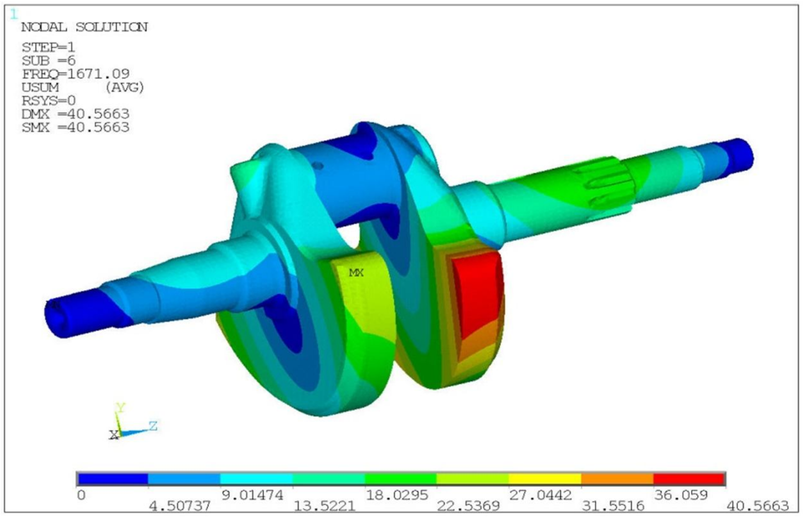

Fig 3.9 Sixth vibration model of CI crankshaft.

Case 2:- Frequency case of Al-SiC crankshaft

In frequency case the boundary conditions are applied on the crankpin area and 6 modes of vibrations are derived as shown in table 02.

Model orders	1	2	3	4	5	6
Frequency in Hz	510.036	672.324	739.99	2000.01	2092.65	2870.24

Table 02:- Natural frequency case

1) First mode of vibration

The first mode of frequency appears maximum at the bottom of the crank web at natural frequency of 510.036

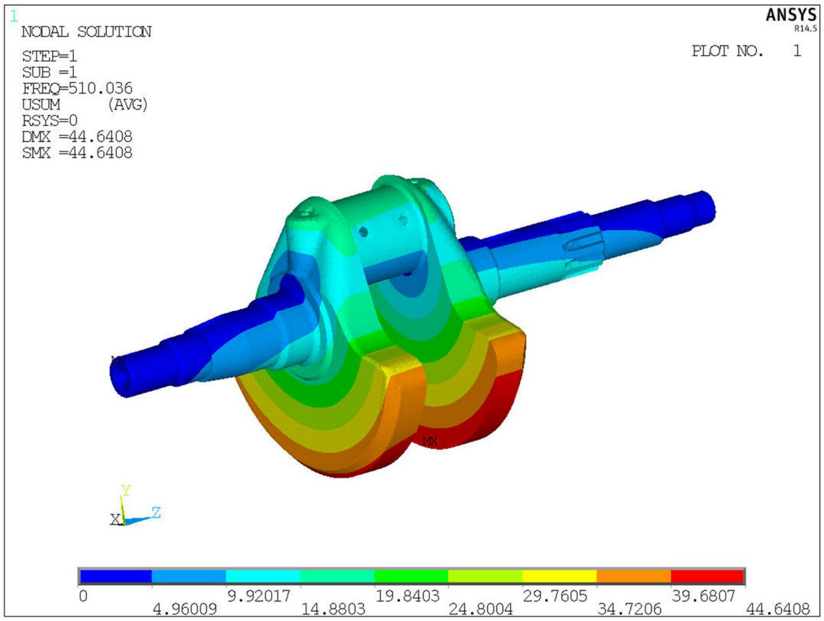

Fig 3.10 First vibration model of Al-SiC crankshaft.

2) Second mode of vibration

The second mode of frequency appears maximum at the fillet radius at natural frequency of 672.324

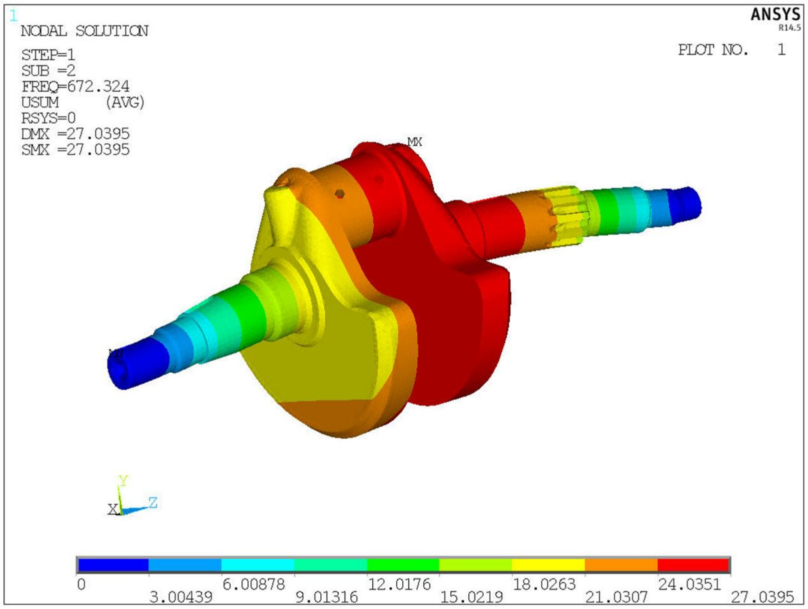

Fig 3.11 Second vibration model of Al-SiC crankshaft.

3) Sixth mode of vibration

The sixth mode of frequency appears maximum at the bottom of the crank web at natural frequency of 2870.24

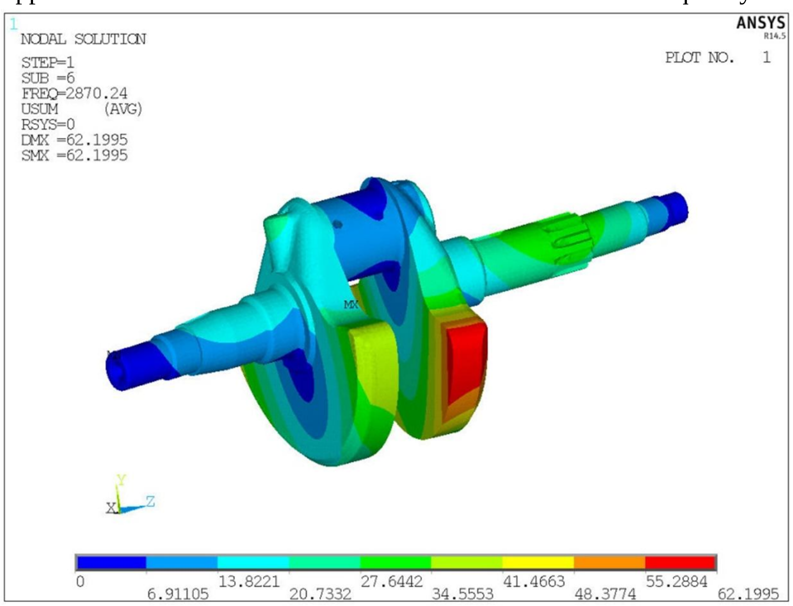

Fig 3.12 Sixth vibration model of Al-SiC crankshaft.

IV. RESULTS AND DISCUSSIONS

In this paper the model of crankshaft is created in UG NX8 and imported to ansys for model analysis

A. From the analysis results the maximum deformation occurs at the centre of the crankpin surface for both the materials.

B. The crankshaft deformation is mainly due to the bending deformation under the low frequency and the deformation maximum at the fillet radius of crankpin and the journal bearing so this area undertakes bending fatigue cracks.

C. For cast iron frequency case the minimum frequency occurred at 1st mode is 295.225Hz, the maximum frequency occurred at 10th node is 3564.62Hz.

D. For Al-SiC frequency case the minimum frequency occurred at 1st mode is 510.036Hz, the maximum frequency occurred at

10th node is 6091.45Hz.

V. ACKNOWLEDGMENT

I would like to precise my thankfulness to many peoples who has assisted during the research. The support given by Manipal University and Faculty is appreciated a lot.

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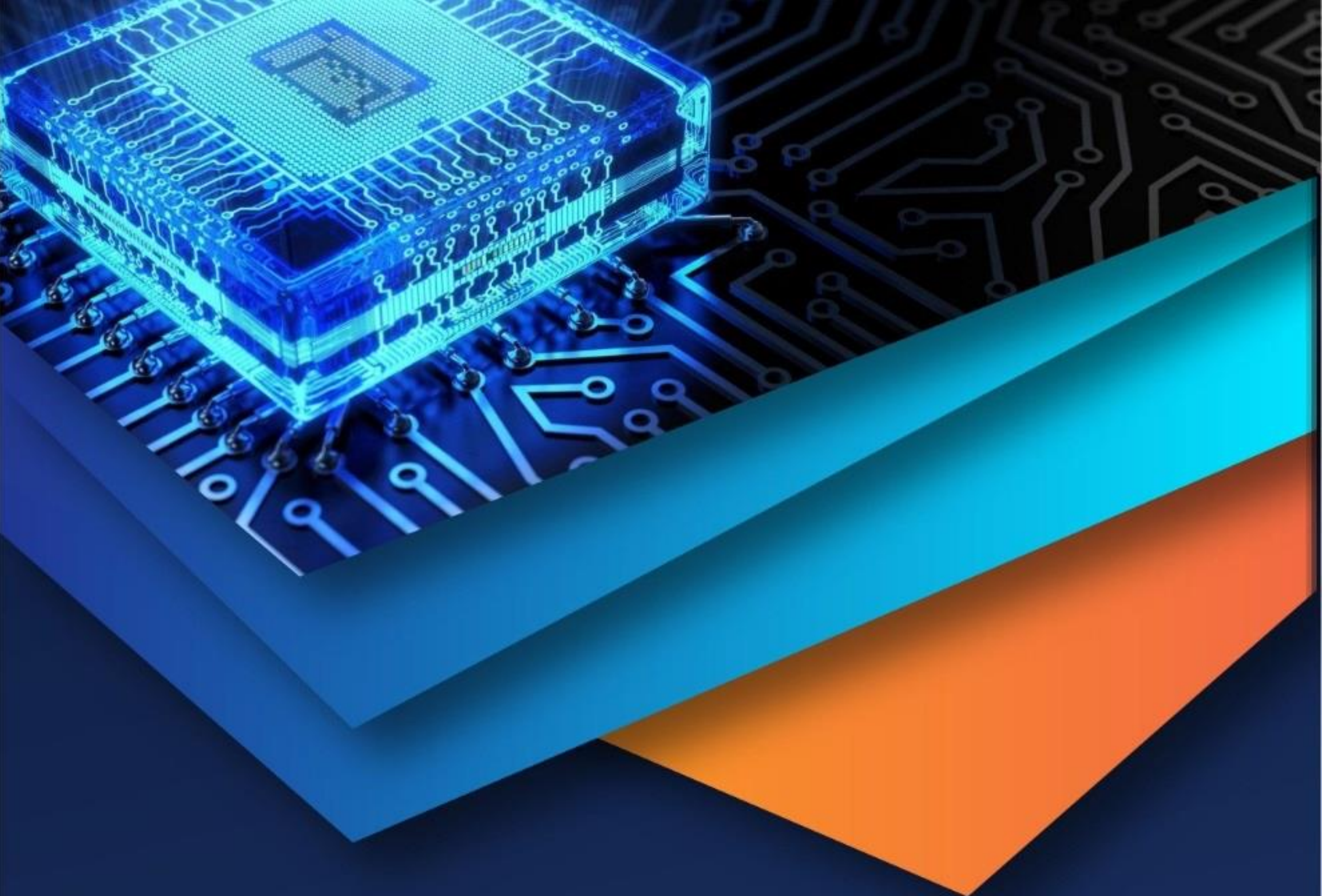

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