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Finite Element Analysis of Submarine Radome

Zeyaullah Ansari[1], Mohd Khalid Ahmed[2], Shahid Hussain[3], S Arun Kumar[4]
[1,2]Asst. Professor in Mechanical Department, Lords Institute of Engineering & Technology, Hyderabad
[3,4] B. Tech Mechanical Engineering students, Lords Institute of Engineering & Technology, Hyderabad

***Abstract:* Submarine receiving wire utilizes Radio Frequency (RF) framework for correspondence .So it is ensured by radome. Radomes are the electromagnetic windows that shield microwave sub-frameworks from the natural impacts.**

Low-observable Radomes are generally made of composite material because of its low dielectric consistent property which is essential not meddle electromagnetic (EM) wave transmission attributes. S-glass composite has low dielectric steady and great quality to weight proportion. Increasing the performance of antenna relies on the best possible choice of material to fulfill the water applications. Composite materials have high quality to weight ratio, high solidness and better consumption resistance are potential source for water applications.

ANSYS Finite Element software used to analyze the issue. The radome design and finite element analysis approval is closed by leading the weight test on radome. The modal examination is likewise done on radome to check for the natural frequency of the radome.

Keywords: Design, Analysis, Pro-E, FEA

I. INTRODUCTION

Radome is typically set over the reception apparatus as a radio wire (antenna) defender. The essential capacity of a radome is to shape a defensive cover between a radio wire and the earth with negligible effect to the electrical execution of the receiving antenna. Under perfect conditions, a radome is electrically imperceptible. How well a radome fulfills this relies on upon coordinating its design and materials creation to a specific application and Radio Frequency extend.

Radomes can be discovered ensuring an extensive variety of open air earthbound and shipboard correspondences frameworks and radar establishments and airborne avionics system antennas. The correct choice of a radome for a given radio wire can really enhance general system performance by:

Maintaining arrangement by disposing of wind stacking, Allowing for every climate operation by shielding the system from rain, snow, hail, sand, salt shower, bugs, creatures, UV harm, and wide temperature fluctuations

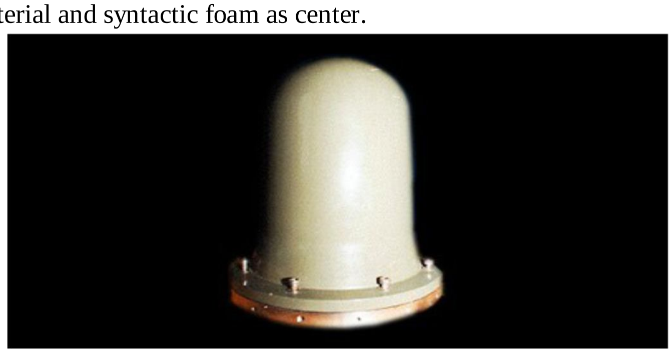
Providing cover for establishment and support personnel

Preventing visual perception of system (security)

Minimizing downtime, and expanding segment and system working life.

II. SHAPE OF THE RADOME

The primary target of this project is to create composite radome which shields the electronic gear from high water weight and straightforward to electromagnetic waves. The geometric shape of the radome is a cylindrical barrel secured with a hemi-round vault at the top. It has a round plate at the base end of the chamber having M6 measure gaps which goes about as a rib. The radome is secured to the submarine structure with M6 darts on its spine. Radome is made of sandwiched development with combination arrangement materials as sheet material and syntactic foam as center.



Submarine Radome

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A. Functions

The Functions of the radome are as per the following

The Radome shields the establishment from the disintegrating impacts of condition and amplifies the sturdiness of radio wire and other gear.

The general execution of the receiving wire will be expanded with the utilization of radome

FRP radome has general economy and weight reduction.

A radome allows the air borne receiving wire to work with great productivity under high leader of the water over the submarine.

B. Construction and Materials

Advanced composites and extraordinary items are produced using fortifications, for example, fiberglass, quartz, graphite and Kevlar alongside lattices, for example, polyester, epoxies and cyanate ester. We additionally utilize center materials, for example, honeycomb (e.g. S-glass fiber reinforced) and froths (e.g, polyisocyanate and thermo-formable centers). Contingent upon the application, these parts are stove cured at temperatures up to 400ºF or in autoclaves, which require high-weight cures at high temperatures. Other materials are additionally accessible for unique applications. Notwithstanding the application(s), we can choose the correct mix of support and network to meet necessities.

IV. SCOPE OF PRESENT STUDY

A test coincidentally into the field of thermosetting polymers has achieved a quantum development in its essential and also innovative viewpoints. The engineered thermosetting polymers with the combinational properties of the current traditional high quality polymers and glass strands with an assortment of filler materials have by and large offered another field of research. The survey of work exhibited here uncovers that extensive exertion has gone into the comprehension of the mechanical, warm and physical properties of thermo sets. A careful writing look uncovers that there are no efficient reviews on mechanical properties of thermosetting composites. There is sufficient degree for creation of more current composites with various weight portions of glass fiber and PET in polymers and there portrayal for physical, mechanical and warm properties. With an assortment of filler Materials have through and through offered another field of research.

V. DESIGN OF RADOME

Pro/E Design was established in Macedonia, Ohio by Brian T Hengle. An alum of Cleveland State University, Brian holds an unhitched male of Civil Engineering with a focus in Structures. He is enrolled in the condition of Ohio as a Professional Engineer. Pro-E is a parametric, coordinated 3D CAD/CAM/CAE arrangement made by Parametric Technology Corporation (PTC). It was the first to showcase with parametric, include based, cooperative demonstrating programming software. The application keeps running on Microsoft-Windows stage, and gives demonstrating, get together and drafting, limited component investigation, and NC and tooling usefulness for mechanical designers. Pro/E Design models are often mixes of different parts, assemblies, drawings, and different items. Pro/E Design makes every one of these substances completely acquainted. That implies if you roll out improvements at a specific level those progressions engender to every one of the levels. For instance on the off chance that you change measurements on a drawing the change will be reflected in the related part. Any adjustment made in any module will consequently make alteration in the other module. So this kind of association from module to module is known as associative.

Initially 2D drawings were created using sketcher toolbar; tools in profile tool bar such As line, circle, rectangle, and point, reference lines etc … and sketch references like grid, vertex, and dimensions are used.

The created drawings were then completely constrained using the tool in constraint tool bar like constraint and auto constraint. Then 2D drawings were converted into 3D using sketch based features tools such as extrude, swept blend, blend.

Table 1.Physical dimensions for radome:

Physical dimensions	Values in mm
Diameter	825.5
Height of Radome	809
Diameter of Hole	28
Thickness of radome	50

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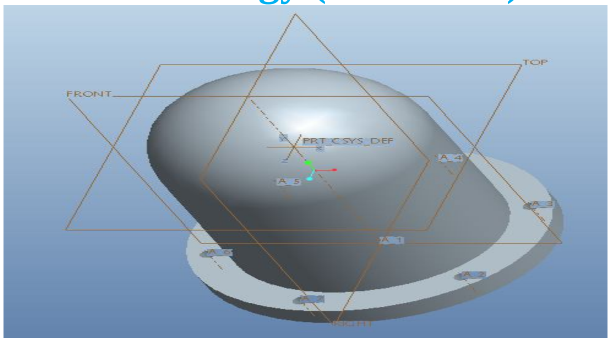

Isometric view of Radome

VI. ANALYSIS OF RADOME

The ANSYS computer software is an LARGE scale multipurpose finite element method program that might be utilized for taking care of a few classes of engineering issues. The ANSYS program has been in business use since 1970 and it is utilized widely in the aviation, car, development, hardware, vitality, benefit, producing, atomic, oil and steel ventures. What's more, many counseling firms and several colleges utilize ANSYS for analysis, research and educational utilize. The program has many extraordinary elements which permit non-freedoms or optional impacts tube incorporated into the arrangement, such as, plasticity, large strain, hyper elasticity, creep; swelling, large deflection contact stress stiffening temperature dependency, material anisotropy and radiation. As ANSYS was created, other unique capacities, for example, surface organizing, sub modeling, irregular vibration, piezoelectric, coupled field examination and design improvement was added to the program. These abilities contribute further to make ANSYS a multipurpose analysis device for changed designing order.

A. Structural analysis

Table no 2: material properties

S.no	Properties	ALMMC
1	Young's Modulus (GPA)	93
2	Poisson’s Ratio	0.23
3	Density (g/cm3)	2.49

Calculation for maximum load conditions for Radome
The following different load cases considered for designing radome:
Water head pressure acting on Radome (due to under water)
Water head Pressure acting on radome (P) = ρgh.
Density of sea water at average temperature of 25^0C (ρ) = 998.0479 kg/m^3
Radome depth in water (h) = 490 m
P= 998.0479*10*490
= 4.9920*10E6
P = 50 bar
Results

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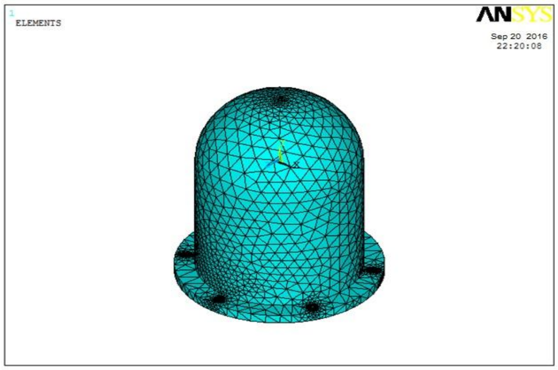
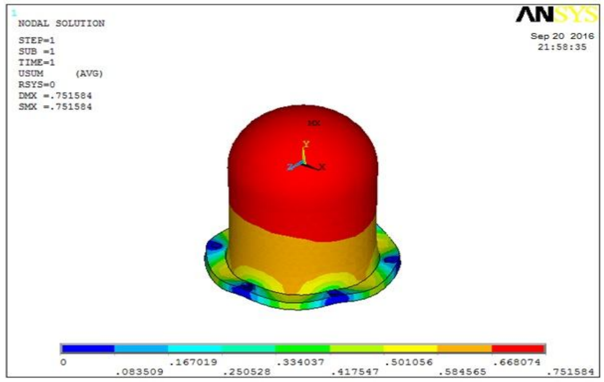
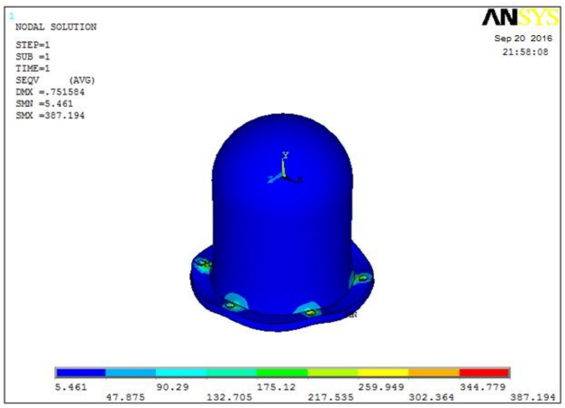


Meshed Model



Displacement vector sum



Equivalent (Von Mises) Stress

B. Model analysis

The procedure for a modal analysis consists of four main steps:
Build the model.
Applying loads and obtains the solution.
Expand the mode shapes
Review the results.
Modal Analysis is done to locate the natural frequency (normal recurrence) of the radome. The natural frequency of the radome ought to harmonize the excitation frequency so reverberation does not happen.
Analysis Type –Modal
Analysis options-select Block lanczos-ok
Frequency-0-1000
No. of modes to extract=10-ok
Solution
Solve-Current LS-ok
Solution is done
General post processor:
Read results-by pick-select mode-ok
Plot results-Counter plot-Nodal solution-Deformation- USUM-OK

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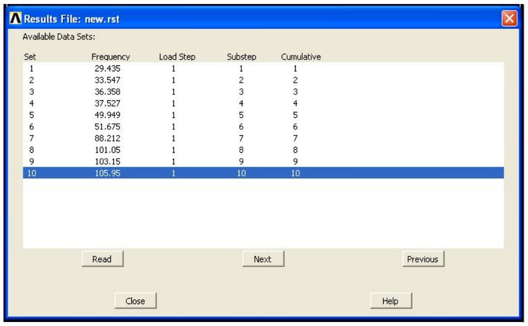
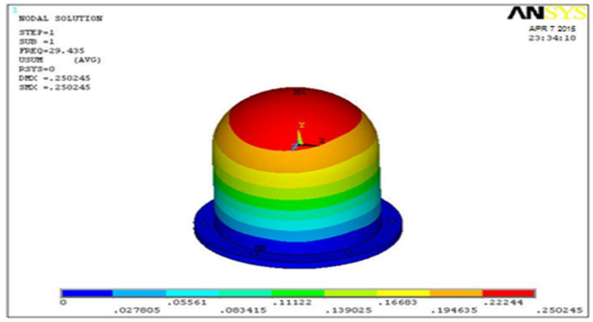
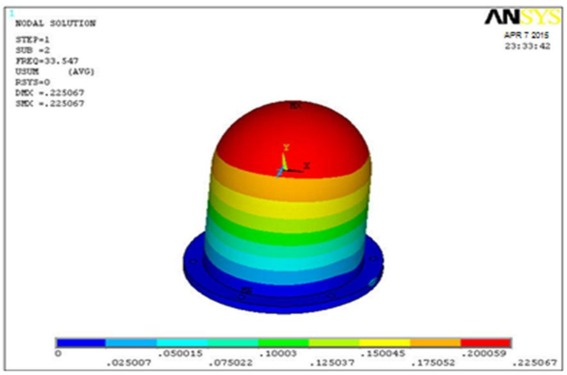


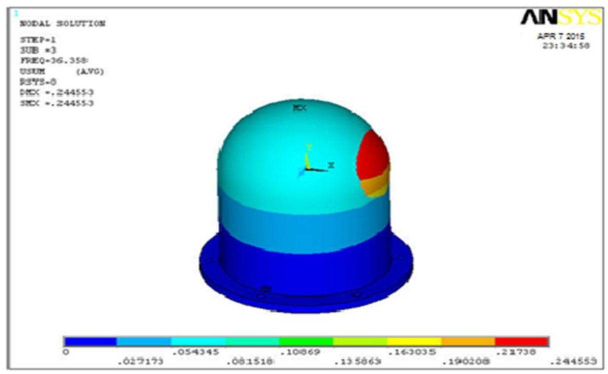
Modal analysis list of frequencies



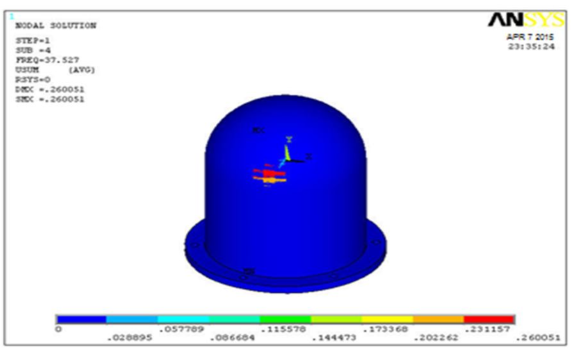
Frequency and mode shape of sub step 1



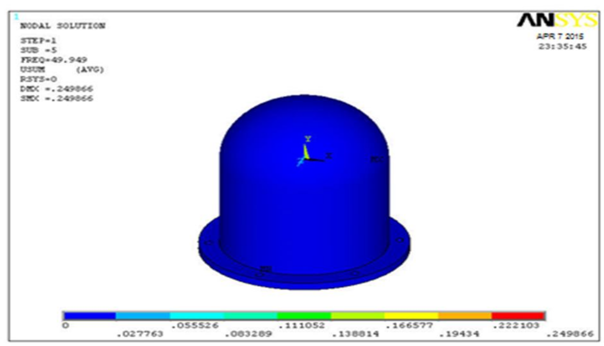
Frequency and mode shape of sub step 2



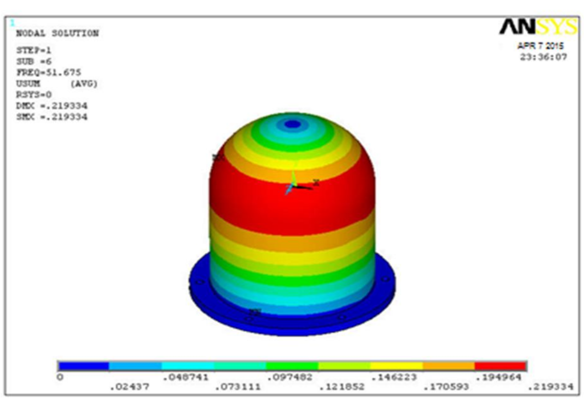
Frequency and mode shape of sub step 3



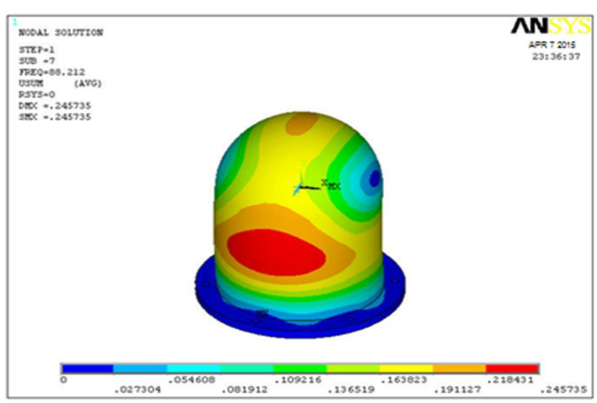
Frequency and mode shape of sub step 4



Frequency and mode shape of sub step 5



Frequency and mode shape of sub step 6



Frequency and mode shape of sub step 7

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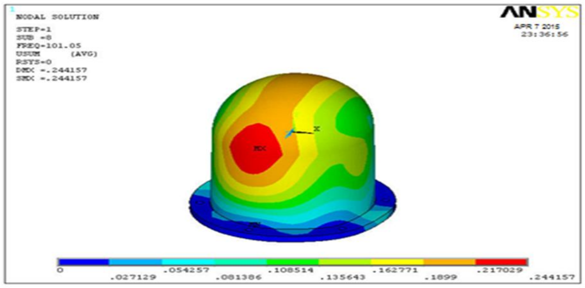
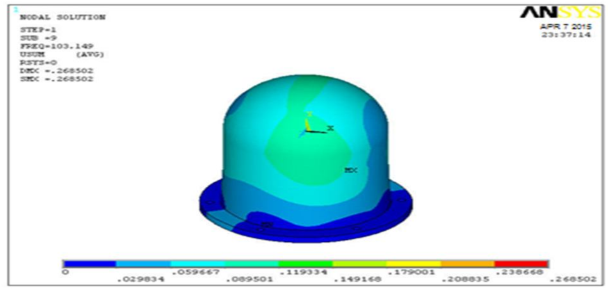
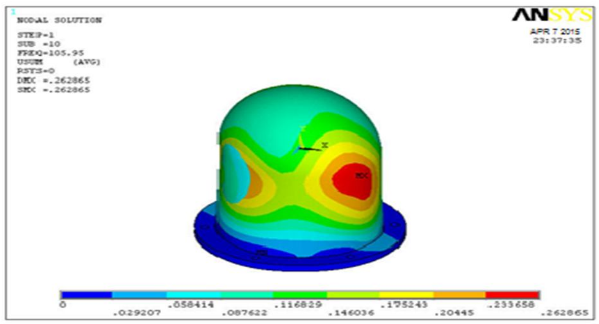


Frequency and mode shape of sub step 8



Frequency and mode shape of sub step 9



Frequency and mode shape of sub step 10

VII. RESULTS AND CONCLUSION

The maximum displacement vector sum found 0.751 mm at top of the radome which is displaying by red color in diagram.

Maximum Von Mises stress found 387 MPa and minimum stress is 5.461MPa. The compressive stress (minimum) is occurs at the center of the radome.

After modal analysis of radome, maximum deflection found at step 9 which is 0.268 mm and natural frequency is 103.149 Hz.

The hydrostatic pressure is conducted on radome is 50bar, the resulted stress is 387Mpa which less than the ultimate tensile stress of S-glass 4750Mpa. So the radome material can withstand under the boundary conditions can operate the depth of 490m

The radome preferable material is S-glass which is low observable dielectric constant which can transmit high frequency to antenna

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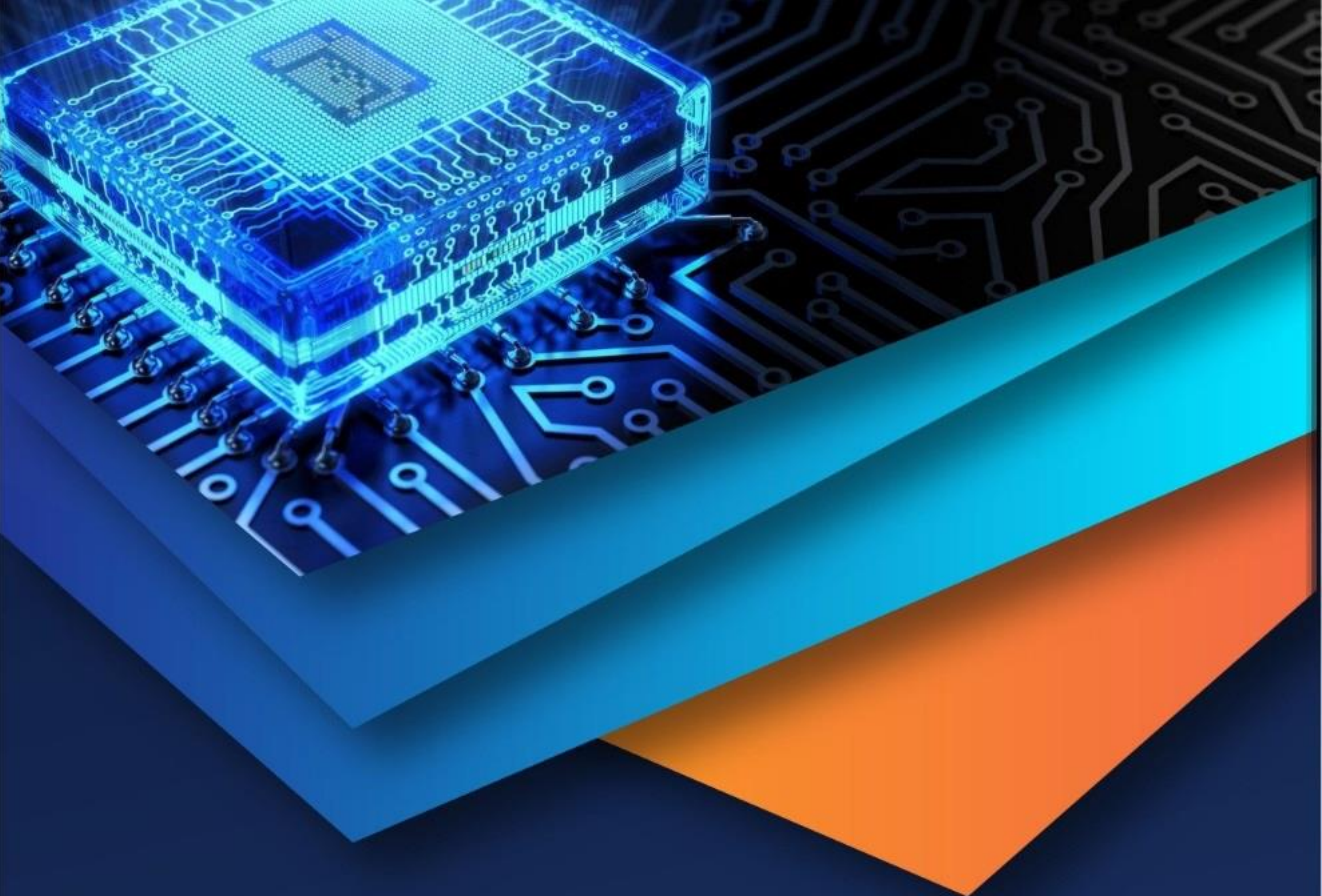

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