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Design of Central Air Condition System for Commercial Shopping Mall

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Abstract: ***The objective to design Heating, Ventilation & Air conditioning (HVAC) system for a commercial Building , with simultaneously controls its temperature, humidity, cleanliness, proper distribution, noise level, heat load calculation, fresh air, exhaust, duct design, pipe design, equipment selection and layout of accessories such as indoor and outdoor unit of the project. Cooling load will be calculated on Hourly Analysis Program software (HAP). Indeed, today the emphasis is no more on understanding air conditioning 'products' but on creating 'solutions' and not just solutions, but 'customized solutions' that suit specific cooling needs of specific business and establishments. Every air-conditioning application has its own special needs and provides its own challenges. Airports, hotels, shopping malls, office complexes and banks need uniform comfort cooling in every corner of their sprawling spaces and activities involving computers, electronics, aircraft products, precision manufacturing, communication networks and operation in hospitals. In fact many areas of programming will come to halt, so air-conditioning is no longer a luxury but an essential part of modern living. With reference to the building plan and requirement of the case problem air-conditioning load is estimated for seasonal conditioning. The project is carried out on "Designing the HVAC system for a commercial Building". To provide human comfort while working, it is very essential to maintain steady temperature at working place.***

Keywords: Reprocessing, The use of fresh type of energy, Less energy utilization, Low poisoning material

I. INTRODUCTION

HVAC (Heating, Ventilation and Air-Conditioning). Preferably installed for single unit, these three functions of the HVAC system are to provide thermal comfort and to maintain good indoor air quality. HVAC can be used for climate control as it provides heating, cooling, humidity control, filtration, fresh air, building pressure control, and comfort control.

HVAC includes a variety of active mechanical/electrical systems employed to provide thermal control in buildings. Control of the thermal environment is a key objective for virtually all occupied buildings. For many years such control may have simply been an attempt to ensure survival during cold winters.

In HVAC "HEAT" is added to develop thermal conductivity to a space or building in order to maintain some selected air temperature that would otherwise not be achieved due to heat flows (heat loss) to the exterior environment. "VENTILATION" is to provide air to or remove air from a space -- to move air without changing its temperature. Ventilating systems may be used to improve indoor air quality or to improve thermal comfort. A cooling system ("C" is not explicitly included in the HVAC acronym) is designed to remove thermal energy from a space or building to maintain some selected air temperature that would otherwise not be achieved due to heat flows (heat gain) from interior heat sources and the exterior environment.

Air conditioning is a field of work that never stagnates. Air-conditioning is commonly used to ease men's environmental problems on earth and in space. The very adverse problems of space environment are also successfully solved with the advanced knowledge of air-conditioning that has made the successful space travel.

The refrigeration and air-conditioning industry in India got the impetus to progress with the dawn of independence in India. This industry has achieved phenomenal growth in less than two decades in our country. The annual output has increased from 800 tons in the early fifties and to about 80,000 tons in 1970. This industry now produces a wide range of light and heavy equipment that has reduced in the import from 50.5% of Air-Conditioning System

A. Background

In 1978 in Scotland by Dr. William Cullen. It was in 1844 that Dr. John Gorrie (1803-1855), director of the U.S. Mariene and Apalachicolla Hospitals, Florida, described his new refrigeration machine. In the world built and used for refrigeration and air-conditioning. since 19O4 HVAC has been recognized as profession some 7O members formed ASRE (American S0ciety of

Refrigeration Engineers). The real "Father of air-conditioning" was Willis H. Carrier (1876-195O) as noted by many industry professionals and historians.

Unit of Refrigeration

Unit of refrigeration is "Ton ". A ton here doesn't mean mass it is a measure of rate of heat transfer. We know that latent heat of fusion of ice is 336 KJ/Kg. When one ton that is 1000 kg of ice melt in 24 hrs it produces cooling effect at the rate of 233 KJ/min. In other words, if heat is removed from water at the rate of 233 KJ/min we get 1000 kg (tone) of ice per day.

B. Compressor

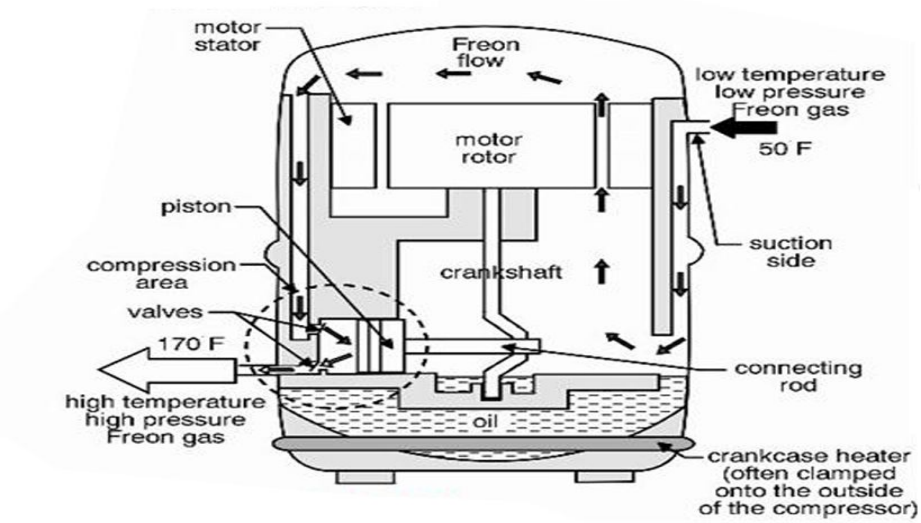

Fig: 1 Compressor

The function of compressor is to compress the low-pressure refrigerant vapor from the evaporator to high-pressure temperature, which the refrigerant vapor can be conveniently condensed to a liquid with the aid of in expensive cooling media, such as atmospheric air or water at normal temperature. Two stage reciprocating compressor and multi stage centrifugal compressor also available for serving scientific application.

1) Positive Displacement
2) Centrifugal

Positive displacement compressors function by reducing the volume of gas in the confined space, thereby raising its pressure. Reciprocating rotary and screw compressors are positive displacements type. Centrifugal compressors functions by increasing the kinetic energy (velocity) of the gas, which is then converted to an increased pressure by reducing the velocity.

The various types of compressors that are in vapor compression system are

a) Reciprocating
b) Centrifugal
c) Rotary
d) Screw

C. Reciprocating Compressors

This is the most widely used type of compressor, available in sizes from fractional horsepower and tonnage up to a few hundred tons. Construction is similar to the reciprocating engine of a vehicle, with piston cylinder, valves, connecting rods and crankshafts. Open type compressors have an exposed shaft to which the electric motor or other driver with both compressor and motor sealed in a casing. In this way there is no possibility of refrigerant loss from leaking around the shaft. The motor is cooled by refrigerant in a hermetic compressor.

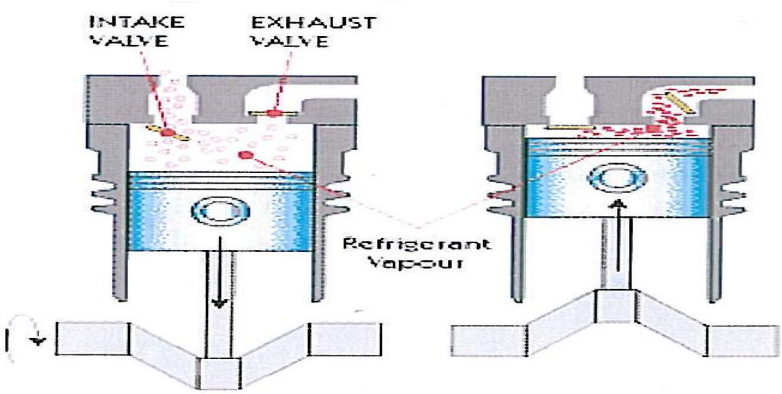

Fig : 2 Reciprocating Compressor

D. Centrifugal Compressor

This type of compressor has veined impeller rotating inside a casing, similar to a centrifugal pump. The impellers increase the velocity of the gas, which is then converted into pressure increase there by decreasing the velocity.

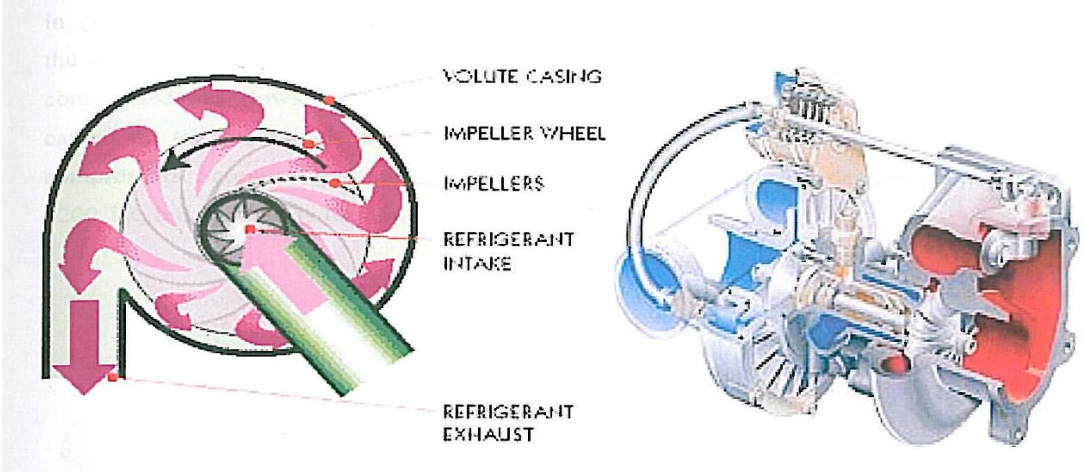

Fig: 3 Centrifugal Compressors

E. Rotary Compressors

This type has a rotor eccentric to the casing, as the rotor reduced the gas volume it increases its pressure. Advantages of this compressor are that it has few parts it is of simple compressor and can relatively quite and vibration free. Small rotary compressors are often used in house hold refrigerators and windows air conditioners.

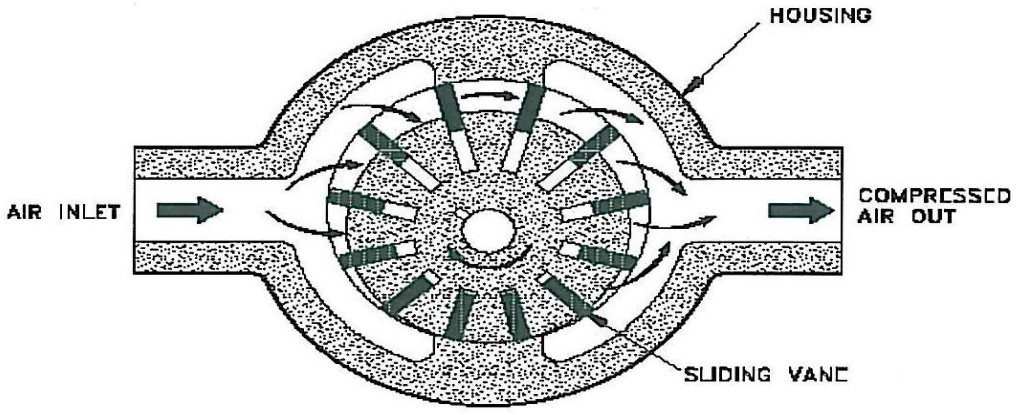

Fig: 4 Rotary Compressors

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F. Screw Compressor (Helical Rotary Compressor)

The meshing helical shape screws rotates and compress the gas as the volume between the screws decreases towards the discharge end. These types of compressors have become popular in recent years due to its reliability, efficiency and cost. It is generally used in large size ranges of positive displacements compressor, in capacities up

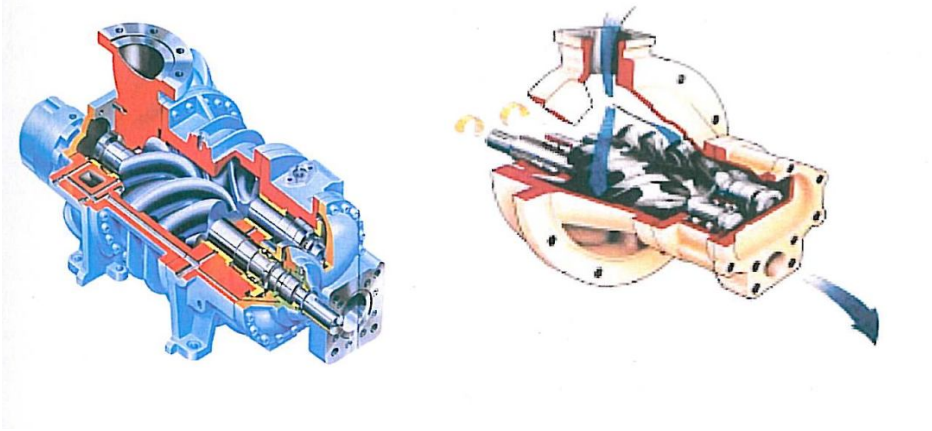

Fig: 5 Screw Compressor

G. Evaporator/Chiller

These may be classified into two types of air conditioning service, dry expansion evaporator (DX) and flooded evaporator. In the dry expansion type, refrigerant flows through tubing and there is no liquid storage of refrigerant in the evaporator. In the flooded type evaporator, a liquid pool of refrigerant is maintained

H. Dry Expansion (Dx) System

These are of two types DX-cooling coils and DX-chillers. Cooling coils are used for cooling air and chiller for cooling water and other liquids. Flooded evaporators are also called flooded chillers. When cooling air, dry expansion (DX) cooling coils are used. The tubing is arranged in a serpentine coils and is finned to produce more heat transfer for a given length.

Chilled Water System: Evaporators in which water and other liquid are cooled are called chillers. In the shell and tube type evaporator a bundle of straight tube is enclosed in a cylindrical shell. The chiller may be either the flooded type, with water circulating through the tube and refrigerant through the shell or dry expansion, with the reverse arrangement. The shell can be made in one piece or can be constructed with the reverse arrangement.

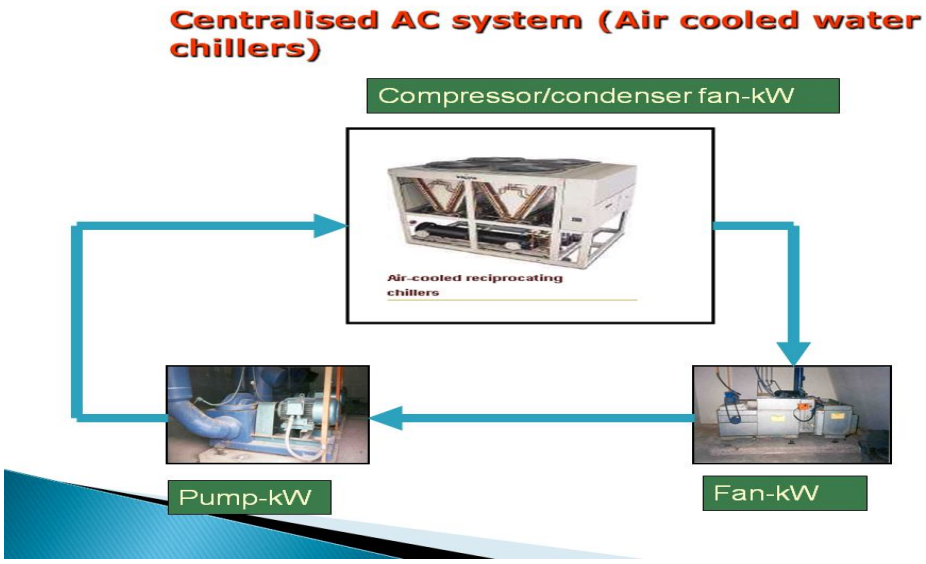

Fig: 6 Chiller Plant System

I. Condenser

The function of the condenser is to superheat the high-pressure gas, condensate it and also sub cools the liquid. Heat from the hot refrigerant gas is rejected in the condenser to the condensing medium (air or water). Air and water are chosen because they are naturally available. Their normal temperatures range in satisfactory for condensing refrigerants.

J. Air Cooled Condenser

In the cooled condenser, the refrigerant circulates through a coil and flows across the outside of the tubing. The motion may be caused by natural convection effect when the air is heated, or the condenser can include a fan to increase the airflow rate, or the condenser are normally installed outdoors they are available in the sizes up to 50 tons.

K. Water Cooled Condenser

There are three types of condensers, which fall under these category 1 tube water cooled condenser are used only of shell and tube evaporator's water from lakes, river or wells is sometimes used when available. Usually natural sources of water are not sufficient, and the water must be re circulated through a cooling tower.

L. Evaporative Condenser

Evaporative condensers reject heat to the atmosphere as the air-cooled condensers, but by spraying water as well as the air, increasing the capacity of the condensers.

M. Refrigerants

Any substance capable of absorbing heat from another required substance can be used as refrigerant are classified in to

1) Primary
2) Secondary

The (a) refrigerant directly take part in refrigerant system where as secondary refrigerant are first cooled with the help of primary refrigerants and are further used for cooling purpose.

Requirement for Refrigerants

The generally requirement for any refrigerant are

a) It should be non-poisonous
b) It should be non-explosive
c) It should be non-corrosive
d) It should be non-inflammable
e) Leaks should be easy to detect
f) It should be operated under low pressure (low boiling point)
g) It should be non-toxic (not harmful if inhaled or if spilled on skin)

II. LITERATURE REVIEW

Types of Air-Conditioning Systems

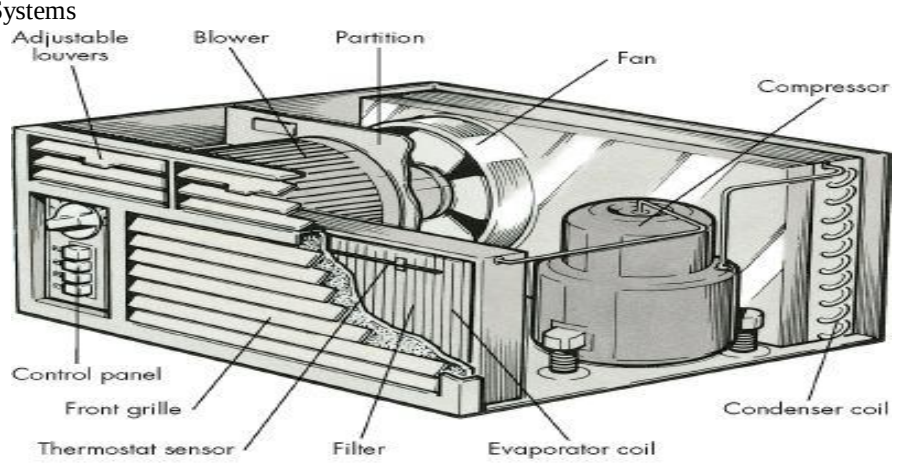

Fig: 7 Basic Window Air Conditioner

Commercial Air-Conditioning According To Application:

This includes air-conditioning of multi room structure like apartments, hotels, office buildings and hospitals. Although treatment varies somewhat for these applications, the basic problems are the same.

1) Individual control of room temperature is desirable.
2) Cooling system should also be suitable for winter heating to eliminate duplication of risers and equipment.
3) Unusual heat loads should be considered.
4) Fan noise, air noise and cross talk between rooms through ductwork are undesirable.

When these requirements are considered in conjunction with loads and equipment, it is not difficult to understand why quality air-conditioning for multi room buildings are more costly per unit capacity than many other types of comfort installations.

Central Air Conditioning Plant

This is the most important type of air conditioning system, which is adopted when the cooling capacity requires 25 ton or more. The central air conditioning system is also adopted when airflow is more than 300 m3/min or different zones in a building are to be air-conditioned. In this system a return air duct is also provided.

The central air conditioning system can be either of the direct expansion system (DX system) or the indirect expansion system (Chill Water System). In the direct system, the airflow from the space to be air-conditioned is circulated over the cooling coil in which the low-pressure refrigerant liquid is boiling. This is known as direct expansion system (DX system).

III.AIM & OBJECTIVE

Generally, HVAC Systems are designed and defined to produce in multiple results of controlling Temperature, Moisture and the Air Quality inside the building spaces. The indoor conditions of the buildings are meant to be planned at more comfortable conditions than the outdoor atmosphere. If the outdoor conditions are cooler, the indoor are maintain with higher temperatures by heating, and if the outside conditions are hot, cooling is supplied to have lower the temperature, both to provide occupant comfort.

Commercial building ventilation must be effective for controlling airborne transmission and preventing outbreaks of infectious diseases. A correlation exists between ventilation, air movements in buildings and the transmission of infectious diseases. Poorly designed, maintained in Residential and often lead to poor IAQ. This may cause sick building syndrome (SBS), various occupational hazards. The main objective is to keep it more comfortable inside the house than it is outside.

IV.METHODLOGY

These days most modern Residential Buildings are equipped with air Conditioning. The technology is also utilized to maintain Indoor Air Quality (IAQ). Many, even most, systems are designed in such a manner that they cannot reliably provide fresh air. But in this system conditioned air is supplied to each room. Fresh is also provided to each FCU.

ASHRAE definition, is a system that must accomplish four objectives simultaneously. These objectives are to: control air temperature; control air humidity; control air circulation; and control air quality

The air conditioning system believed so far offers the only source of air with consistent temperature to the total space, managed by one space thermostat and one spacehumidistat. Though, in a lot of buildings there are numbers of spaces with diverse users andcarrying thermal loads, these carrying loads may be because of different in the interior.

Uses of the spaces, or because of changes in cooling loads because the sun shine in to a few spaces and not others. Therefore, our easy system, which supplies the only source of heating or cooling, should be customized to provide independent, variable cooling or heating to each space. There are a number of areas where energetic research and discussion are going on. Interior air quality is one that straight effect on us. In many realms of the world there is a fast rise in asthmatics and rising displeasure with indoor air quality in buildings and airplanes. The reasons and effects are very compound. An important scientific and engineering field has planned to investigate and tackle these matters. Greenhouse gas productions and the demolition of the earth's defensive ozone layer are concerns that are inspiring research and predominantly refrigerants.

Latest legislation and guiding principle are evolving those problems:

A. Reprocessing
B. The use of fresh type of energy
C. Less energy utilization
D. Low poisoning materials

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V. RESULT

Compiled Data for Chilled Water Plant
Air – Cooled Chiller

1) Plant Information

Plant Name ..... CHILLER
Plant Type ..... Chiller Plant
Design Weather ..... NAGPUR, India

2) Cooling Plant Sizing Data

Maximum Plant Load ..... 158.1 Tons
Load occurs at ..... Jul 1500
ft²/Ton ..... 195.9 ft²/Ton
Floor area served by plant ..... 6404.0 ft²

3) Coincident Air System Cooling Loads for Jul 1500

Air System Name	Mult.	System Cooling Coil Load (Tons)
GF	1	40.7
FF	1	36.8
SF	1	37.7
TF	1	42.9
Total Ton of Refrigeration		158.1 TR

System loads are for coils whose cooling source is ' Chilled Water ' .

VI. CONCLUSION

Based on the inputs & room data sheets and data Summary sheet the projected TR will be calculated. To offset this load we propose to provide Chillers with a standby option. Three will be as duty chiller while other one will be as standby.

The Air cooled Chillers and the pumps will be located in the Chiller plant room assigned for the purpose on the Roof Deck floor. The plant room will be duly ventilated. The FCU's will also be located on the Roof Deck Floor.

It is proposed to incorporate a primary water distribution system in the AC system design. The Primary system will comprise of a set of Primary pumps which will circulate the water to the chillers and they will circulate the water from the chillers to the Various Zone are constant speed type. By this pumps need not run at particular speed always and hence energy is saved.

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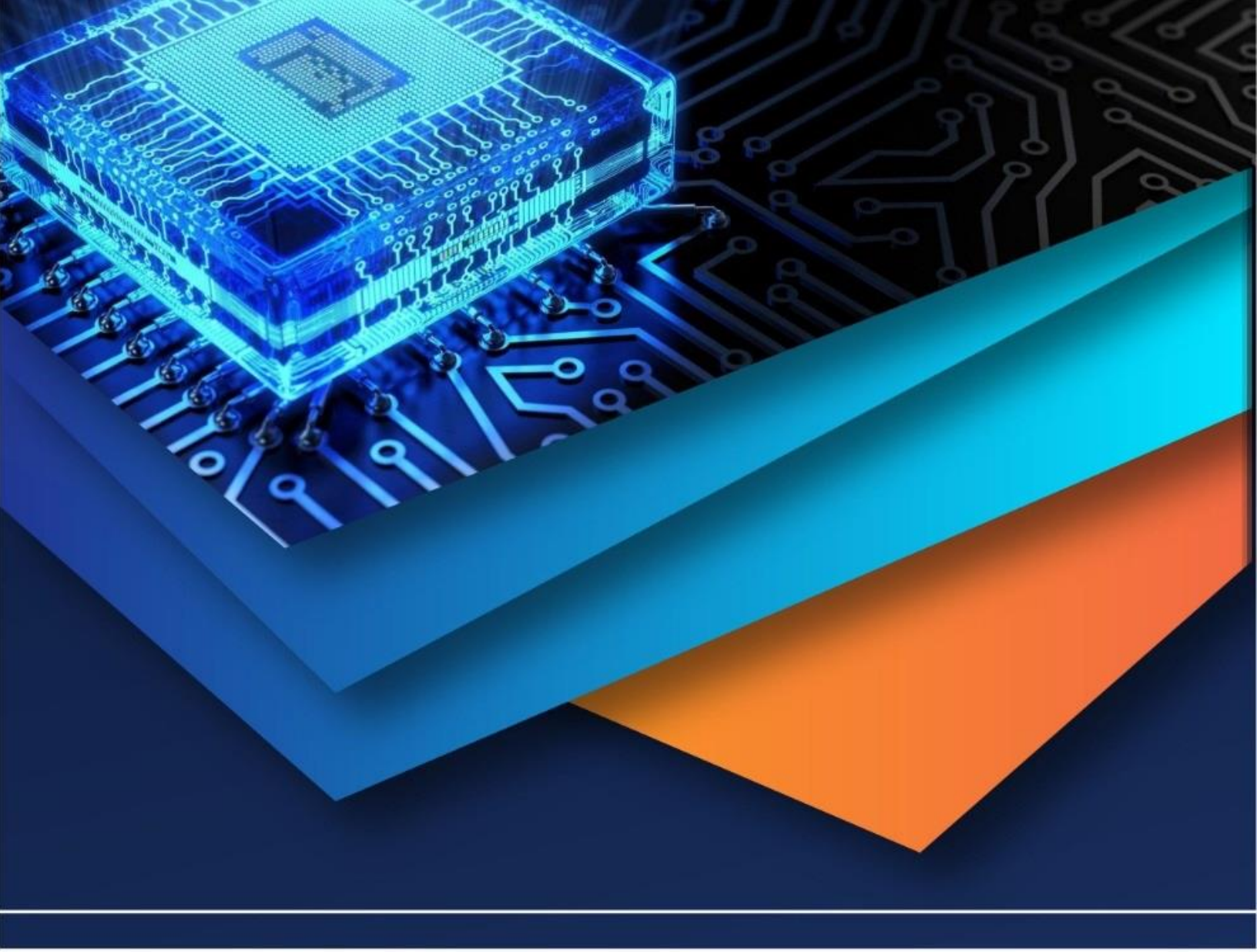

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