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Study Trend of PM10 as Air Pollutant in Chandigarh: Case Study

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Abstract: ***In the current study, air quality analyses for particulate matter (PM10) were performed in the city of Chandigarh. To create average data for the city, data was gathered from a real-time monitoring station located in Chandigarh's sector 25. Every 24 hours, every month, and every season had average concentrations computed. The highest and lowest monthly PM10 concentrations were recorded in the months of October in 2020 and February in 2021, respectively, and August and September in 2020 and 2021, respectively. The monsoon season had the lowest quantities, whereas the winter season had the highest concentrations. Then, using the daily average data, statistical relationships between the air pollution and some meteorological characteristics were computed. The speed of the wind, the relative humidity, and sun radiations were taken into account.***
Keywords: Particulate matter, PM10, Meteorological parameters, Air pollution trend

I. INTRODUCTION

Over the past few decades, India has experienced an enormous rise in population along with uncontrolled urbanization, which has had a negative impact on urban climate, air quality, and general regional climatic imbalances. With an increase in the consumption of fossil fuels (coal and petroleum), particularly in the transportation sector, thermal power plants, smelters, industries, etc., air quality has deteriorated to moderate to critical levels in major Indian cities. Particulate Matters (PM) is one of the seven conventional (criteria) pollutants (including SO2, CO, particulates, hydrocarbons, nitrogen oxides, O3 and lead). These pollutants cause the greatest amount of air pollution and pose the greatest risk to the health and welfare of people. a focus on these contaminants, particularly in urban areas.

Smoke, mist, spray, fumes, soot, and dust, which comprise the majority of particulate matter (PM), can all be categorized as pollutants based on their size and composition.

Fine solid particles with a size range of 1 to 100 microns make up dust. Many issues are brought on by the presence of contaminants in the atmosphere. Size affects how PM affects health. Their toxicity, lung damage (such silicosis, black lung disease), mutagenic and carcinogenic properties, irritation of the eye, nose, and throat, and heart damage are a few of the key issues (Lung not as efficient, heart must work harder to get oxygen).

Chandigarh is a landlocked Union Territory, thus there is no chance for growth and, presumably, no chance for the length of the roads to increase. Studies have demonstrated that the city's traffic pollution has a major impact on Chandigarh's air quality. The fleet of vehicles is over 2 per capita households.

In India, Chandigarh has the greatest vehicle density. The number of vehicles on the road, roadside dust, burning of dry leaves, litter from city trees and gardens, and the use of generators in some nearby areas are the main causes of air pollution in Chandigarh. Stubble burning in Chandigarh's surrounding areas during particular times of the year. The current study shows daily, monthly, and seasonal fluctuations in PM10 and PM2.5 concentrations as well as the impact of weather factors including wind speed, relative humidity, and sun radiation on these pollutants.

II. DATA COLLECTION AND ANAYLSIS

A. Study Area

Chandigarh, the study area, is a union territory in northern India with a 114 km2 area, located at 30 0 44' 14" N and 76 0 47' 14" E. Chandigarh's climate is classified as Koeppen's CWG, which means that it has a hot summer, a cold, dry winter, and a subtropical monsoon. There are 1.05 million people living there, with 9258 people per square kilometer (Indian Census 2011). In India, Chandigarh is referred to as Chandigarh Tricity along with the neighboring cities of Panchkula (Haryana) and Mohali (Punjab); these cities are responsible for a large influx of automobiles into the city.

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B. Sampling Methodology

Chandigarh Pollution Control Committee (CPCC) observed air quality at 3 locations in Chandigarh. The site includes Panjab University South Campus, Opp. Centre for Public Health Institute, Sector 25, Govt. Model SR. SEC. School, Sector- 22-A, Forest Department Nursery, Sector-53. In this study only data of year 2020 and 2021 is taken from station situated in sector 25 Chandigarh. Among the measured data in that station PM10 was chosen. Then the averages were calculated for each month and each season by excel. Finally, averages of the data were used to create graphs of the city's PM10 concentration that depict the diurnal, monthly, and seasonal changes in air pollution. The next phase was researching how metrological characteristics affected PM10. Wind speed, relative humidity, and solar radiation are some of the metrological characteristics that were investigated.

III.RESULT AND DISCUSSION

A. Monthly Variation

Figure displays monthly variations in average mass concentrations of PM10. Peak monthly PM10 average mass concentrations were observed in October, reaching 120.8 g/m³ for the year 2020, and 124.6 g/m³ for the following year, 2021. In 2020 PM10 decreased from march to august due to restriction on traffic movement and closing of industries and again increased due to some relaxation in lockdown. Mainly coarse particulate concentration increased in case of dust storms. The lowest monthly average concentration of 33.9 µg/m^3 in the month of august for year 2020 and 38.9 µg/m^3 in September for year 2021. Additionally, precipitation and stronger convective air currents assist in the removal of coarse particles. The annual average PM10 concentration is 91.69 g/m³ in 2021 and 76.23 g/m³ in 2020, which is higher than the national ambient air quality guidelines i.e. 60 g/m³

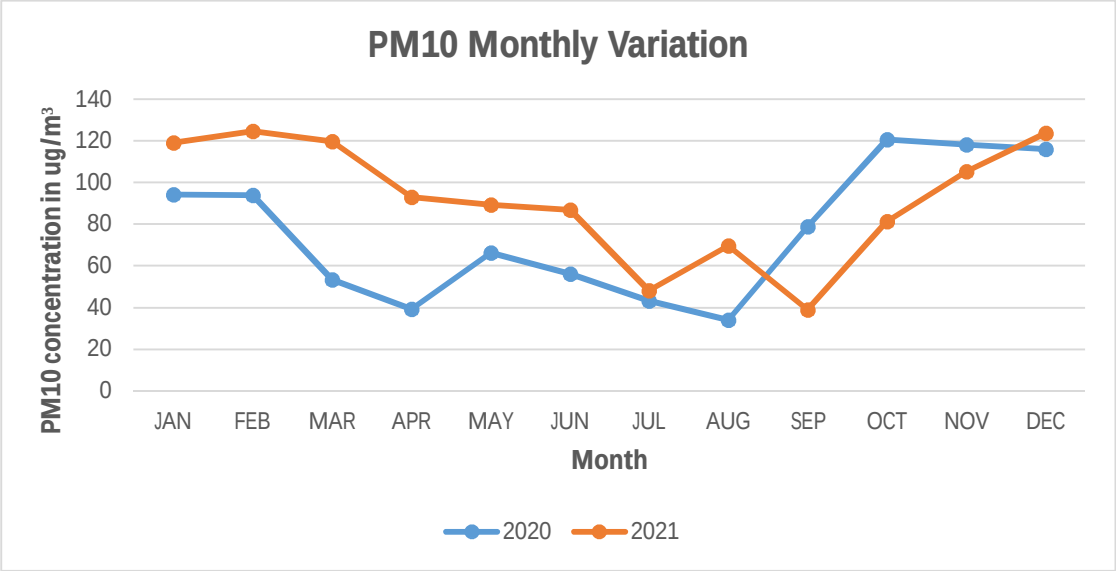


Fig.1

B. Seasonal Variation

Seasons have a significant impact on air quality in the Indo-Gangetic Plains, hence the effect of seasonality on different pollutants at all locations was also investigated. The concentration of PM10 has been seen to rise during the winter and autumn months. The cause is that there are more polluting activities throughout the winter. Wintertime sees an increase in people burning biomass, which consists of burning farm stubble, to heat their homes. The lowest concentration of PM10 is during monsoon season,

The air quality in Chandigarh City is impacted by the seasonal burning of crop residue following the rabi and kharif crop harvesting because it is surrounded by the agricultural states of Punjab and Haryana (Ravindra et al., 2019b). Additionally, other agricultural processes (such as ploughing and harvesting) and weather factors can have an impact on air quality. According to Ravindra et al., the elevated PM10 concentration over Chandigarh during the time when crop residue was being burned was 151.45 106.40 g m-3 (2019b). The study showed that these seasonal burning events have a significant impact on local air quality and that weather patterns are crucial in the development of air pollution in the Indo-Gangetic Plains. Depending on the pollen season, Chandigarh's higher vegetation cover could also result in an increase in pollen concentration and have an impact on the air quality. (Guttikunda et al. (2019) also highlighted how transboundary pollutants and seasonal dust storms both contribute to the air pollution in Chandigarh.

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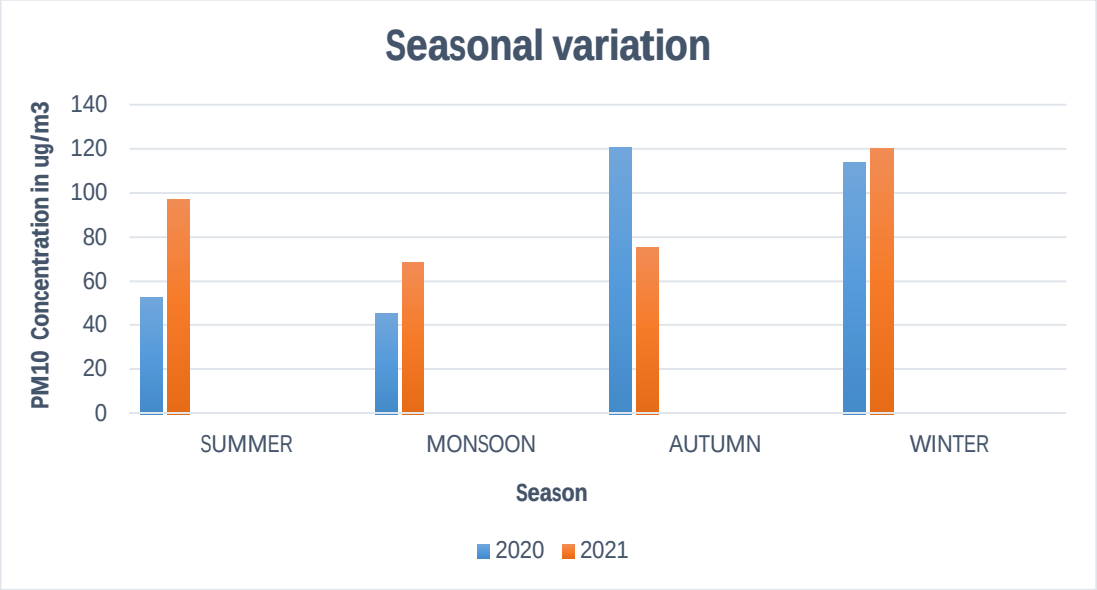


Fig.2

C. The Relationship of Concentrations of Respirable particulate matter (PM10) with meteorological variables

Variations in meteorological parameters (relative humidity, solar radiations and wind speed) and concentrations of pollutant PM10, could be seen through graphs shown.

PM10 and RH are inversely correlated. Concentrations drop experienced during months (Aug, Sep) as wet deposition of particulates increases with increased relative humidity.

The concentration of PM10 increases as relative humidity starts decreasing in month of October, November and December. It is seen in graph that PM10 and wind speed is inversely proportional. As wind speed increased concentration of particulate matter decreased as in months of October, November and December i.e. winter season reported maximum concentration of PM10 corresponding to lower wind speed in year 2020 and in December in year 2021.It is seen that when solar radiations increased in month of April, may, June i.e. summer season concentration of PM10 has been decreased.

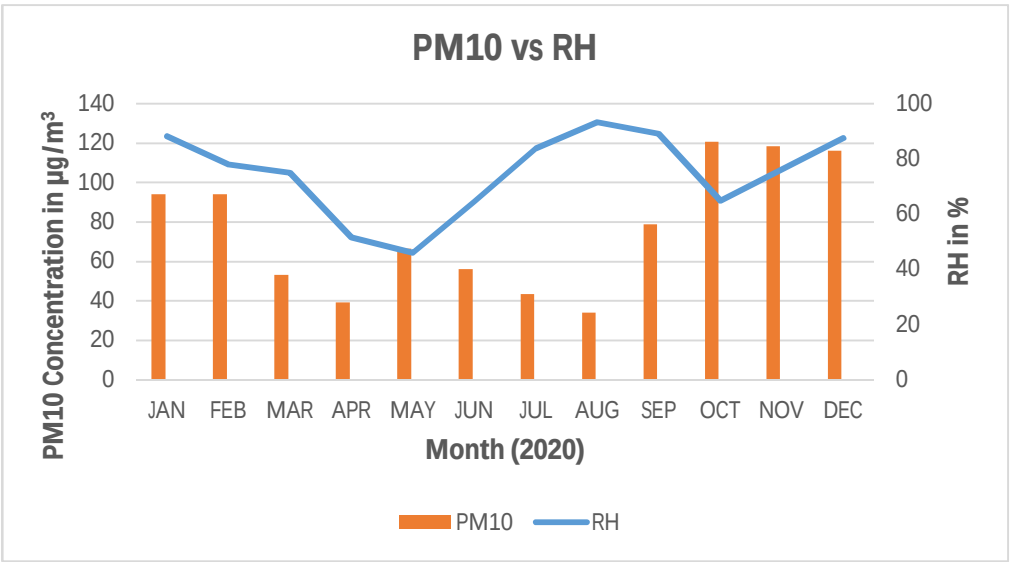


Fig.3

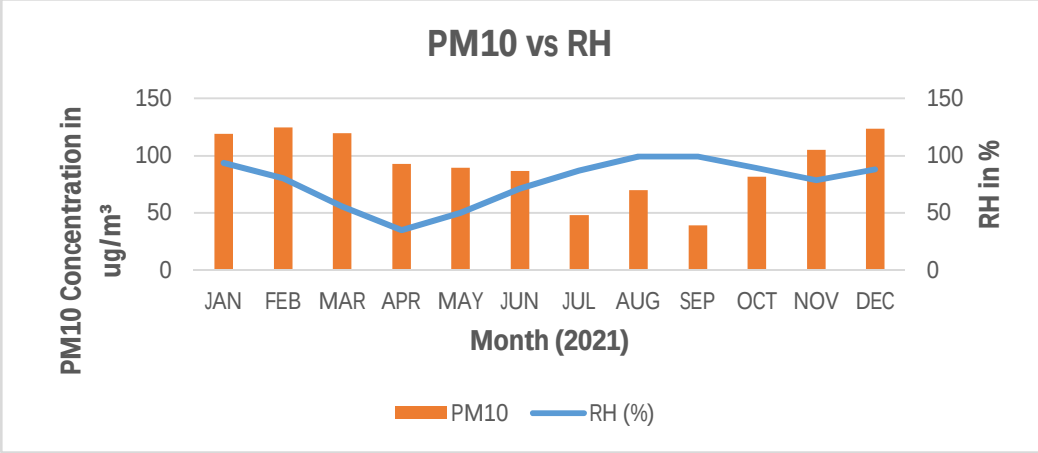


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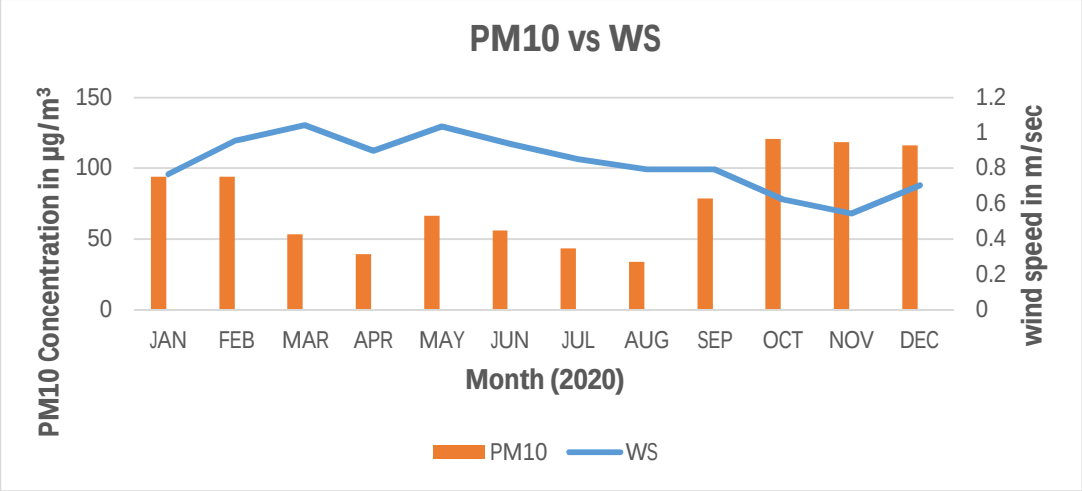


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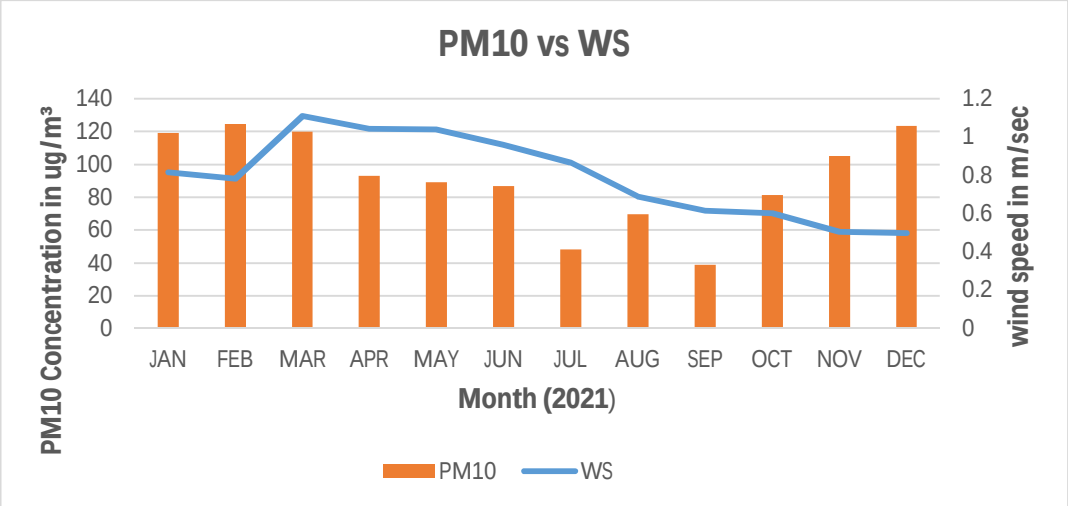


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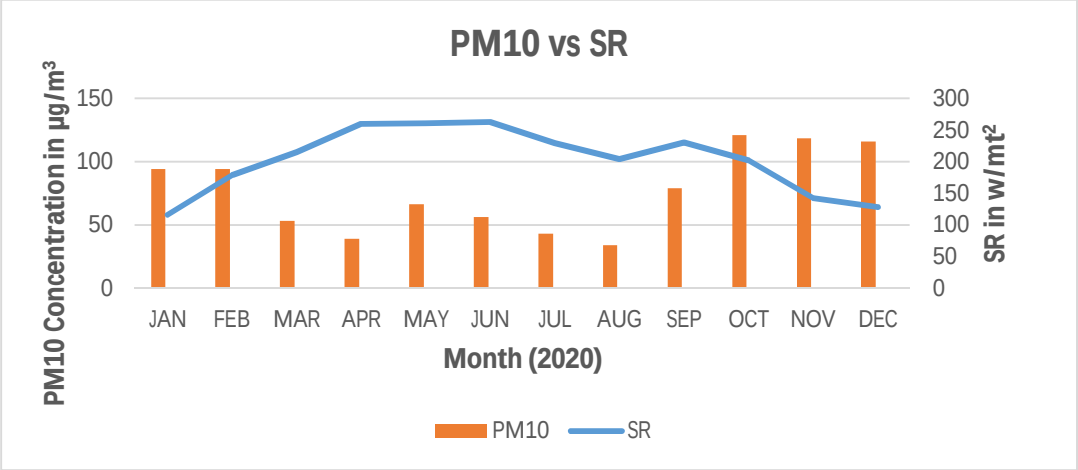


Fig.7

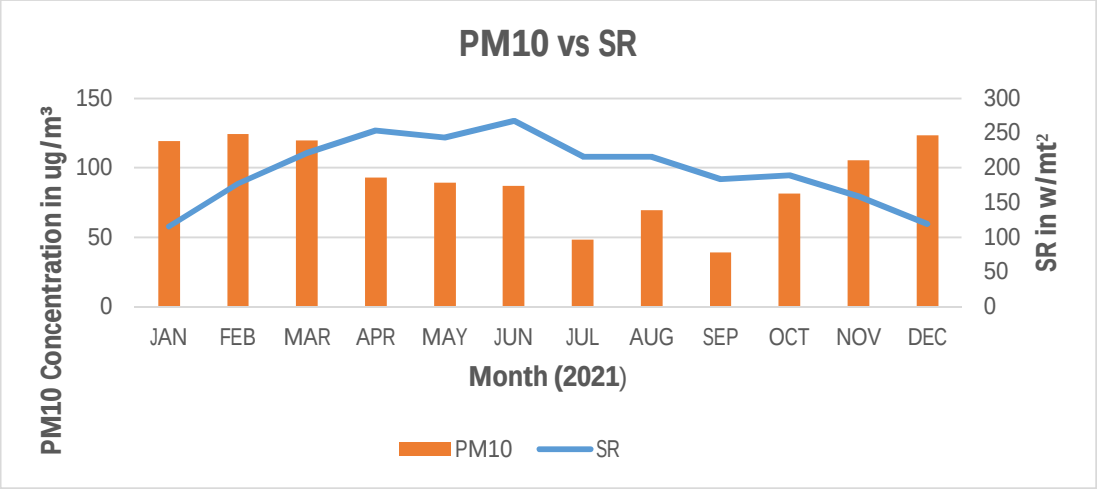


Fig.8

IV. CONCLUSION

In this research air quality analyses for Chandigarh, Capital of Punjab and Haryana, are conducted for PM10. According to the findings, there is a significant correlation between various climatic characteristics and PM10. Additionally, various fluctuations in concentration over the duration of the months and seasons were observed. Unfortunately, all the monthly and seasonal graphs showed that the concentrations of the PM10 are upper than Primary Standards of PM10 showing unhealthy condition.

Average monthly variation of PM10 shows that pollutant concentration is less in year 2020 because of restriction on vehicular movement due to covid lockdown in Chandigarh and pollutant concentration increased in year 2021 due to relaxation in traffic movement. The concentration of PM10 is higher in month of January, February, November, December i.e. Winter season The annual average PM10 concentration for the years 2020 and 2021, respectively, was 76.2 g/m³ and 91.6 g/m³, above the 60 g/m³ national ambient air quality standards.

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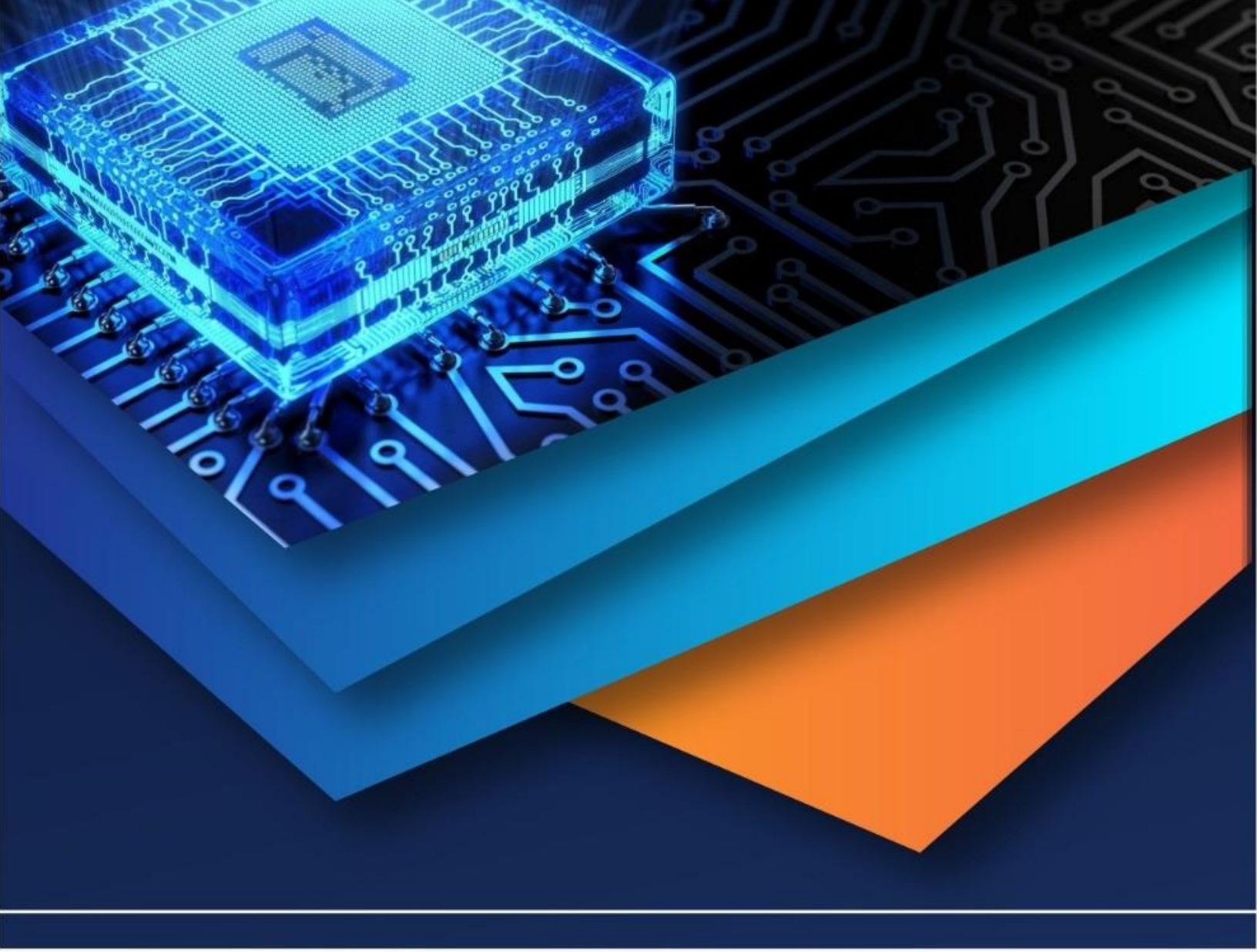
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