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Physico-Chemical and Biological Analysis of Water and Effect of Contamination on Residents of Area Ner Chowk, District - Mandi (H.P.)

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Abstract: ***The approximate population (2020) of the Nerchowk area is about 52944, an area of 80.26 km², and a population density of 659 people per km². Sample Collection Sites at Nerchowk Region. 31°36'24"N, 76°54'51"E longitude and latitude of Nerchowk.***

The present cross-sectional study is focused on measuring the quality of drinking water in areas of Nerchowk region, District – Mandi, Himachal Pradesh, India, and its effects on human health as told by the people living in these areas. Various analyses including physical, chemical, and microbiological assessments were carried out on the water samples collected from the villages. The present thesis aimed to assess and compare the water quality with WHO standards and its related health effects on residents of the Nerchowk Area. 30 sample sites are chosen nearby the Nerchowk area and water samples have been taken from each area. Data collection is based on the laboratory analysis of water samples. The study was carried out over 12 months that is, August 2021 to July 2022.

Keywords: Physico-Chemical and Biological Analysis of Water, Effect of Contamination on Residents of Area Ner Chowk,

I. INTRODUCTION

The summary of the literature indicates that much research work is done by experts in the area of Physico-Chemical and Biological Analysis of Water and the Effect of Contamination on Residents. Through it, we come to know that many testing and analysis results for studying the effect of water contamination have already existed. It is concluded from the literature that to take care of the health of human beings water analysis is very much important. Very less research work is done around north India and especially in Himachal Pradesh state. Very less research work on Physico-Chemical and Biological Analysis of Water is present in the Himachal Pradesh state. Proper investigation of the physical, chemical, and microbiological parameters of the water should be done in the Himachal region so that people can ensure water quality.

II. GAPS IN EXISTING LITERATURE

1) No proper research work is carried out on the chemical analysis of the water in the Nerchowk area.
2) Very less literature is available regarding the effect of water contamination on human health in the selected area.
3) Very less experimental data were found regarding the effect of impurities on human health.
4) The understanding of water contamination parameters and their relation to the residents is still limited and yet to be studied.
5) Many researchers have done a detailed study of chemical analysis of water and the effect of water impurities on the health individually but their combined or relative study has not been carried out yet.
6) Combined Physico-Chemical and Biological Analysis of Water and the Effect of Contamination on Residents yet to be carried out.

III. PROBLEM FORMULATION AND OBJECTIVES

Various analyses, parameters, testing techniques, and behavior of the water have been studied in the detail. There is a great requirement for water treatment or purification in some regions on a priority basis. Pure water for household purposes is essential for a healthy life. Separate study about the physical, chemical, and microbiological behavior of water is available up to a great extent. But the combined and cross-sectional study is limited and especially for developing countries like India. Keeping in view the gaps in existing research work a combined study for a specific area can be performed to test water quality and analyze the effect of contaminants on the health of the people.

The goal of this study is to look at the link between drinking water quality and human health and longevity. The aims and objectives of the present study are as follows: -

1) To analyze water physically, chemically, and biologically.
2) To study the causes of water contamination.
3) To study the physicochemical and biological analysis of water.
4) To examine how to improve the water quality.
5) Effect of various impurities on human health.
6) To identify the locations of bottlenecks for clean water and eliminate them.
7) To investigate techniques for minimizing the water impurities.
8) To find opportunities for water conservation.
9) To perform the various possible water tests and observe water quality.

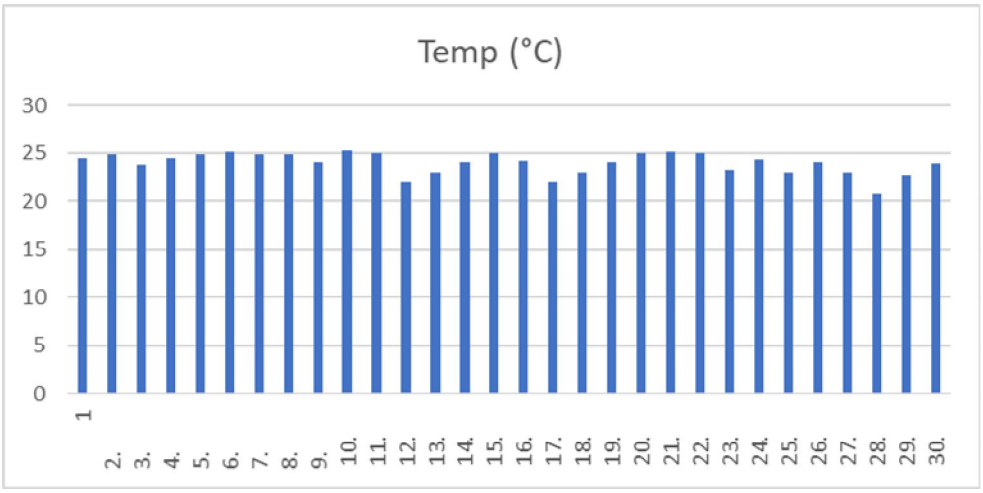
IV. VARIOUS PHYSICAL, CHEMICAL, AND MICROBIOLOGICAL TESTS

A. Various tests in the lab are performed on 30 water samples to determine their various values and compared with permissible limits.

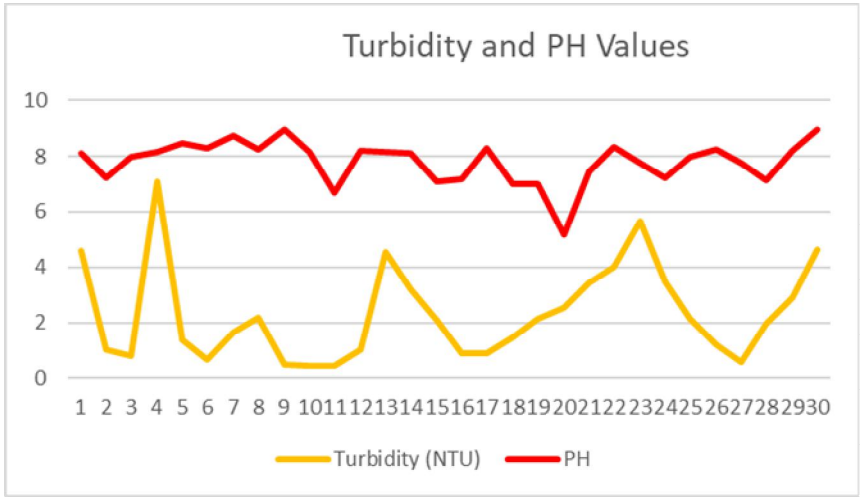
TABLE 1, Various Physical Tests

Sr. No.	Physical Quantity	Measuring Instrument / Chemical Used	Units	Remarks / Permissible Range
1.	Temperature	Digital thermometrer	°C	Normal Temprature
2.	Colour	Solution of specific concentration of [Cl_6K_2Pt + $C_{l2}CoH_{12}O_6$ + HCL] used	Hazen Units or C.U. (color Unit or chloplatinate unit)	5-15 C.U.
3.	Odor	Concentrated HCL used	No Units	Agreeable (odorless) or Not Agreeable (having any odor)
4.	Taste	NaCl of Specific Concentration	No Units	Agreeable/Normal or Not Agreeable/Abnormal
5.	Turbidity	Digital Turbidity Meter	NTU	1-5 NTU
6.	PH	Digital PH Meter	No Units	6.5-8.5
7.	Conductivity	Digital Conductivity Meter	µS	200 to 800 µS/cm

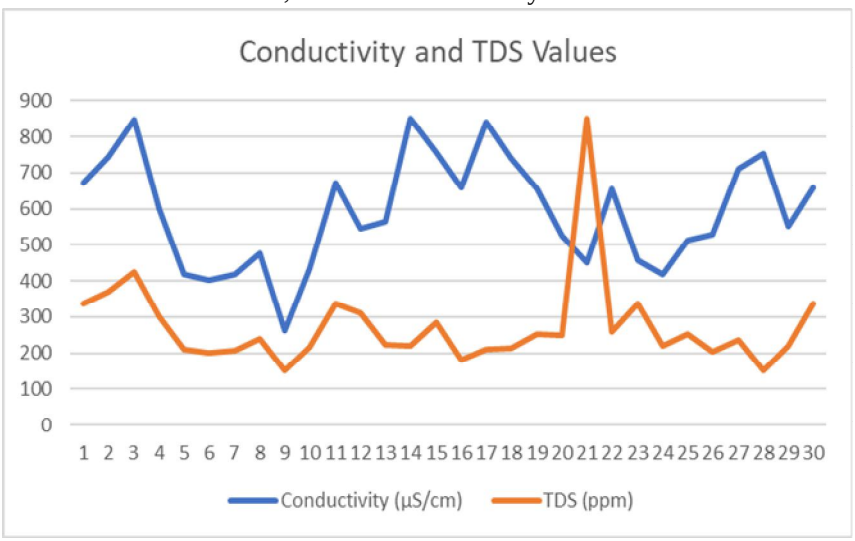
GRAPH 1, Variation of temperature for 30 water samples



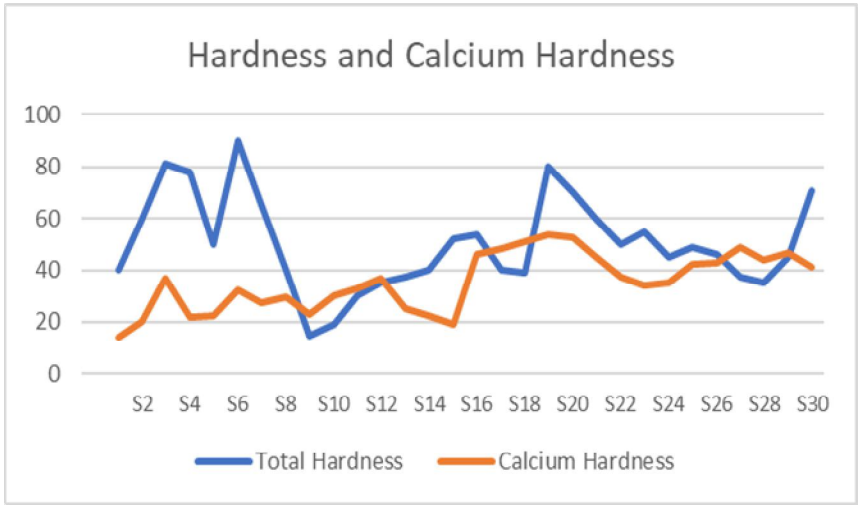
GRAPH 2, Values of turbidity and PH



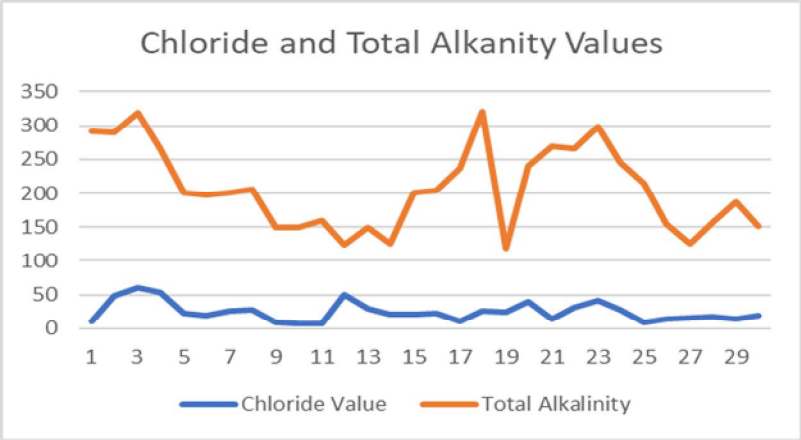
GRAPH 3, Values of conductivity and TDS



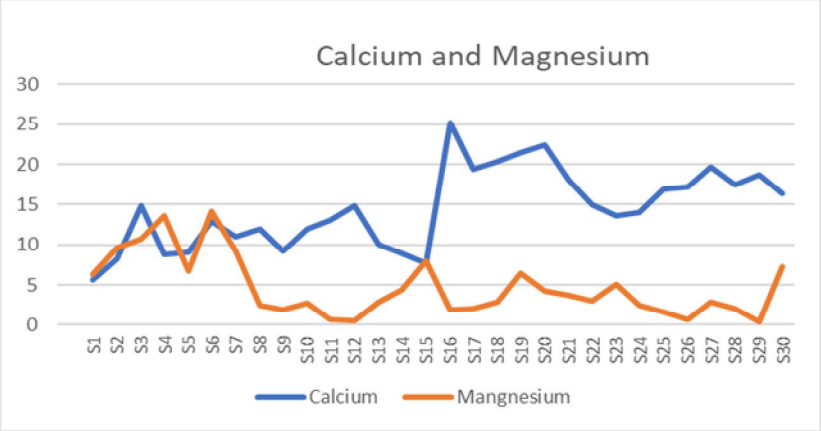
GRAPH 4, Values of hardness and calcium hardness



GRAPH 5, Values of chloride and total alkalinity



GRAPH 6, Values of calcium and magnesium



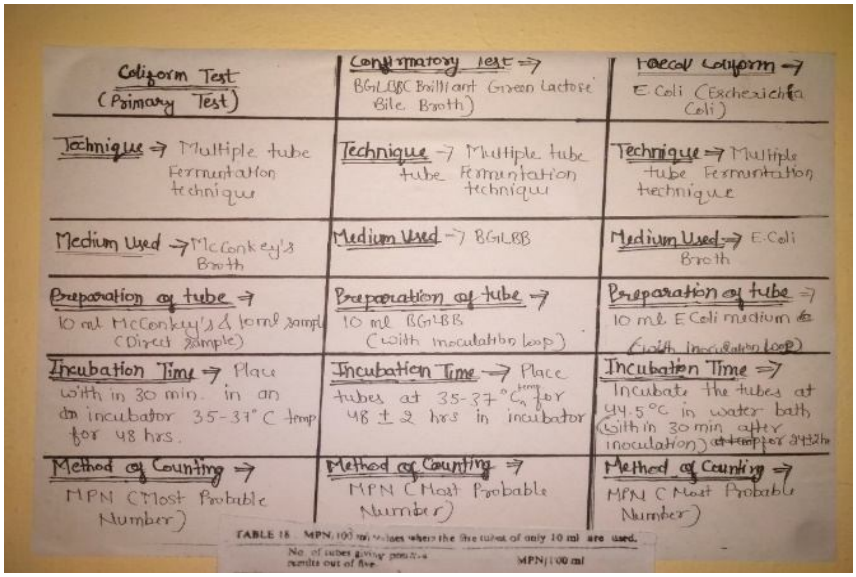
B. Various tests in the lab are performed on 30 water samples to determine their various values and compared with permissible limits.

TABLE 3, Various Chemical Tests

Sr. No.	Physical Quantity	Measuring Instrument / Chemical Used	Solution in Burretee	Indicators
1.	Calcium	Titrate with respect to NDTA , (A-B) × 4	NDTA solution	NaCl and NaOH
2.	Magnesium	(total harness – calcium harness) × 0.244		
3.	Chloride	Titrate with respect to, silver nitrate (A-B) ×10	N/50 Silver nitrate used.	Potassium chromate
4.	Alkalinity	Titrate with respect to H_2SO_4 , (A-B) ×20	H_2SO_4 has a concentration of 0.02N	Phenolphathline
5.	Hardness	titrate concerning the EDTA, (A-B) ×20	EDTA solution,	Erichrome Black – T, ammonia buffer
6.	Calcium Hardness	multiply the calcium value by 2.497		
7.	Arsenic	Arsenic testing kit		

C. Bacteriological Tests

Fig.1 Bacteriological tests



1) Total Coll Forms: Use the standard procedure for tests. Take 10mL media and Durham's tube in auto clove 15lb/in2. Media prepared in auto clove and the put-in laminar airflow. Put a 10 mL sample in the test tube and insert media into it and observe for bubble formation. Then put all samples in an incubator for at least 48 hours.

2) E-Coll: Only performed if the only previous test is positive. In our case, all water samples are passed so need not perform this test.

V. DISCUSSION

The objective of this thesis was to perform the analysis of the water in the Nerchowk region on the physical, chemical, and biological aspects and to check the effect of the contamination on the health of the residents. In the light of the collection of data, findings, and analysis, the following inferences can be made-

1) Improvement should be done in waste disposals and sewage methods.
2) Time to time audit of water at various locations is necessary.
3) For getting more accurate and precise results month-wise analysis should be done for at least two years and then the results should be summarized.
4) Authorities should regulate and monitor the water supply as well as personal resources from time to time.
5) All personal or public water sources should be kept neat and clean.
6) Tanks, containers, etc. which are used for storing water should be cleaned by proper methods weekly.
7) The study area is very small, analysis should be done on a large area and for a longer time for better results.
8) Due to the limited lab and technical support heavy metal analysis is not performed in this presented work, heavy metal analysis should be done.
9) At least 5-year-old data from hospitals etc. can be collected for analyzing the history of any water disease.

VI. CONCLUSIONS

From the analysis of data gathered from literature, the internet, and various journals on physical, chemical, and biological analysis of the water, as well as various analyses performed in this study in the Nerchowk area we concluded all samples collected from various sites are safe for drinking. All samples collected are tested chemically, physically, and bacteriologically for the various possible aspects and they are found all quantities are under permissible limits and water is safe for household tasks.

1) The taste and color of water samples are agreeable.
2) The odor of all samples is marked as odorless.
3) No residual chlorine is found.

4) No arsenic traces are found.
5) Calcium and magnesium values are within permissible limits.
6) Hardness and calcium hardness are in an acceptable range.
7) Alkalinity, Chloride values, TDS, conductivity, turbidity, and PH values are in permissible ranges.

VII. SCOPE OF FUTURE WORK

For a detailed analysis of water quality in the Nerchowk Area, the monitoring and analysis should be carried out for a longer period. The minimum time for such monitoring should be one year to have a series of data or trends to confirm the study's reliability. Standardization of the sampling locations would also help in making the obtained data more comparable with scientific findings. The analysis of water parameters should be analyzed in advanced analytical techniques such as Inductively Coupled Plasma-Mass Spectrometer (ICP-MS) in comparison to FAAS in the future. Besides the chemical and heavy metal analysis, the microorganisms (protozoa parasite, algae, bacteria, and viruses), radionuclides (radioactive materials such as uranium), and disinfectants should be analyzed using advanced techniques such as ICP-MS.

This study seeks to determine how well Ner-Chowk potable water supply conforms with state and national drinking water standards. Questions were posed to residents who are receiving their primary drinking water supply from the IPH Department or any other sources. To analyze any problem in the water chemical analysis should be done. Effect of water contamination in agriculture field should be carried out. Toxicological studies should be carried out to determine the associated potential risks. Domestic waste and agricultural activities affect groundwater quality so the monitoring of fertilizers and pesticides is needed. Programs should be implemented to monitor the bore wells and hand pumps exceeding the limitation of guidelines All public supplies should be checked for microbial safety. Toxic material must be treated chemically and converted into harmless materials. People awareness campaigning should be organized/implemented by the government and non-government organizations. For better health measures bottled water should be checked from time to time. For a detailed analysis of water quality in the Nerchowk Area, the monitoring and analysis should be carried out for a longer period. The minimum time for such monitoring should be one year to have a series of data or trends to confirm the study's reliability. Standardization of the sampling locations would also help in making the obtained data more comparable with scientific findings.

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VIII. LIMITATIONS

This thesis is limited primarily to data collected in the Nerchowk region only. However, results of water quality analyses conducted in some other locations are also included. The limitations of the study can be improved by analyzing more samples throughout all districts of Himachal Pradesh instead of the small region like Nerchowk.

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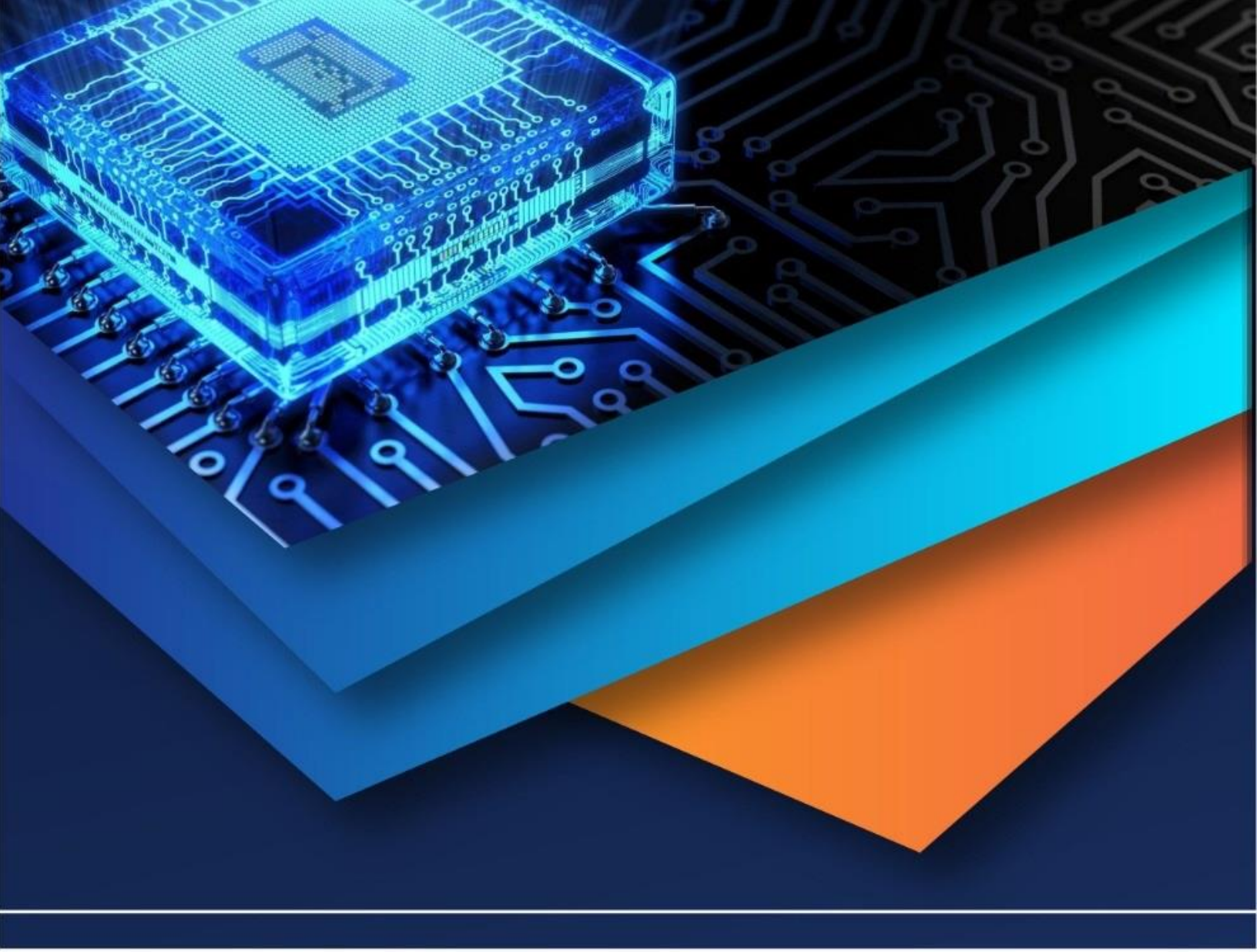

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