iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** VII **Month of publication:** July 2025

DOI: https://doi.org/10.22214/ijraset.2025.73193

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue VII July 2025- Available at www.ijraset.com

Analysis of Water Quality Parameters of Wetland: A Review

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Abstract: ***The wetland is one of the main water resources, which mainly gets contaminated from sewage or wastewater disposal, encroachment, commercial and industrial activity. Water is one of the most important compounds that majorly influence life. It is the most important aspect in land shaping and climate control. The quality of water usually described according to its physicochemical and biological parameters. Rapid industrialization and excessive use of chemical fertilizers and pesticides in agriculture are causing tremendous pollution which reduces water quality and depletion of aquatic flora and fauna. This is the one of the serious problems now a day. As ground water is more valuable than surface water it is necessary to check the water quality parameters at regular interval of time viz. pH, TDS, alkalinity, turbidity, nitrates, chlorides phosphates, BOD, COD, DO, minerals, salts. The study suggests that immediate effort is required to improve water quality and support any future initiatives for restoring wetlands.***

Keywords: Shakya-Sagar Wetland; Water Quality Assessment; Physico-Chemical Analysis; Eutrophication

I. INTRODUCTION

Wetlands are the most lucrative resource having environmental and ecological values on the earth. Wetlands provide ecological as well as hydrological functions such as flood mitigation, stabilization of local climate, nutrient retention, ground water recharge and support biodiversity. Wetlands also provide wide range of ecosystem services like food, fiber, fuel and greenhouse gas regulation through carbon sequestration.

Due to prerequisite hydrological and meteorological condition associated with high water table, high productivity and low decomposition rate wetlands act like carbon sinks which is helpful for mitigation of global warming. Like ecosystem services wetlands support non- market goods and services such as landscape maintenance and sustenance of rural people. But in recent few decades this productive ecosystem has been facing alterations which leads to wetland degradation. Wetlands are important on earth supporting diverse and unique habitat for organisms as well as providing fresh water, fisheries, agriculture, irrigation, industrial activities, and recreation on which many humans largely depend Economic development of any region results into the increasing pressure on wetland hydrology and affect wetland aquatic environment. Water surface temperature is an influential parameter to examine the existing wetland processes such as evaporation, water quality and oxygen concentration in water. In this connection a complete study requires to plan strategies for their protection and preservation.

II. LITERATURE REVIEW

A survey of literature, keeping in view the physico-chemical parameters and biodiversity of various organisms inhabiting wetlands, was carried out. On the physicochemical parameters and biodiversity of various wetlands and other water bodies.

A review on conservation of wetlands of India given by

1) Prasad et al. (2002) described various values provided by the wetlands like building landscapes, nutrient recycling, floodwater attenuation, ground water recharge, providing freshwater for drinking, etc. The authors also suggested various techniques like Remote Sensing, Geographic information System (GIS) and a major element being the use of IRS LISS III sensors for delineating turbidity, aquatic vegetation and major geomorphological classes of wetlands to promote their conservation.

2) Sharma et al. (2008) conducted an extensive survey of aquatic insect diversity of Chandrabhaga River (Garhwal) and recorded 6 orders of insects represented by Ephemeroptera, Trichoptera, Coleoptera, Diptera, Plecoptera and Odonata, with their maximum density recorded in the month of March and minimum in the month of August. They further estimated that of the total aquatic insects, maximum annual contribution was observed by Trichoptera (38%) and Ephemeroptera (32%) and minimum by Odonata (2%).

3) Neeraj Gupta (2016) - Harike, designated as Ramsar site, is the largest manmade riverine wetland in North India. It came into existence in 1952 with the construction of barrage near confluence of rivers Sutlej and Beas. It has high ecological significance as it is the habitat of diverse flora and fauna, source of food for animals and humans and plays an important role in underground water recharge. Despite all these diverse functions, the wetland is facing a threat of extinction because of increasing anthropogenic pressure from industrial development, agriculture and over extraction of water for irrigation. A number of studies have been undertaken to assess the water quality of Harike and the water is found to be unsafe for aquatic life as well as for human consumption. The review deals with the status of Harike wetland in terms of water quality and causes of wetland loss. It also provides an overview of the methodology employed for physicochemical and biological analysis, heavy metal determination and use of remote sensing techniques for monitoring of various water quality parameters.

4) Shailesh.S.Deshmukh (2019) - Assistant Professor Department of Chemistry Pemraj Sarda College, Ahmednagar, Maharashtra. Abstract: Water is one of the most important compounds that majorly influence life. It is the most important aspect in land shaping and climate control. The quality of water usually described according to its physicochemical and biological parameters. Rapid industrialization and excessive use of chemical fertilizers and pesticides in agriculture are causing tremendous pollution which reduces water quality and depletion of aquatic flora and fauna. This is the one of the serious problems now a day. Due to use of contaminated water in day today life human being suffers from water borne diseases. Thus, the analysis of the water quality is necessary to regulate the natural eco system. As ground water is more valuable than surface water it is necessary to check the water quality parameters at regular interval of time viz. pH, TDS, alkalinity, turbidity, nitrates, chlorides phosphates, BOD, COD, DO, minerals, salts. Present research paper focus on review of different research papers related to physico-chemical analysis of water from different sources used for drinking purpose.

5) Yogita Madan, Surbhi Jain (2022) -Unwanted changes in the physical, chemical, and biological features of air, water, and soil pose a serious hazard to people all over the world. Water is highly polluted with various dangerous chemicals as a result of the rising human population, industry, fertilizer use, and man-made activity. Weathering of rocks and leaching of soils, mining processes, mixing of different domestic contaminants (detergents), and other factors contaminate natural water. Because of the usage of contaminated drinking water, various water-borne diseases affect human health; therefore it is vital to monitor the quality of drinking water at regular intervals. This study comprises a water assessment using Physico-chemical parameters. This research data has been collected from Jamwa-Ramgarh, Virat Nagar, Bassi, and Amber tehsil in the Jaipur district during the study period (2019-2022). This paper has included appropriate methodologies for the determination of Physico-chemical parameters. Temperature, acidity, hardness, pH, sulfate, chloride, DO, BOD, COD, alkalinity, and other physicochemical parameters are calculated because they all are necessary to analyze water quality. the determination of the concentration of certain heavy metals (Fe, Zn, Cd, Cu), is also included in this paper because these heavy metals are dangerous to water species and also produce poison inside the water.

6) Rafia Farooquee1, Kangkana Lekharu2* and Epsita Roy (2023) - Wetlands are one of the most diverse, productive and a unique ecosystem present on this earth. Wetlands are the transitional area between the terrestrial and aquatic habitats. Bordoibam Bilmukh Bird Sanctuary is a large freshwater wetland that serves as a breeding ground for many important migratory bird species. The present study is a review study which mainly focuses on analytical review on the physico-chemical properties of water of the Bordoibam wetland with special reference to its avifaunal diversity. The various physico-chemical properties of water including water temperature, pH, conductivity, dissolved oxygen (DO), and total dissolved solids (TDS) were analysed and found in a range of pollution indicator index. These databases will also help in future researches to assess the quality of water of the wetland. The study also focused on the variety of bird species found in the wetland along with their local name, English name, scientific name, IUCN status and their feeding habit. At present Bordoibam wetland is a hot area for future research. During the study we have faced problems in collecting data, as there were very less number of papers written and available on the Bordoibam wetland.

7) Nimmi, N (2024) Wetlands are highly productive ecosystems on Earth and are essential for the existence and survival of life. They provide valuable services including the preservation of water quality, water supply, groundwater recharge, the balance of atmospheric gases, sequestration of carbon, cycling of nutrients, preservation of shorelines, maintenance of distinctive biota, fishery resources, fodder for livestock, and contribution to educational, cultural, and recreational resources. However, wetlands are experiencing tremendous stress from various factors such as rapid urbanization, industrialization, infrastructure development, land use changes, agricultural intensification, agrochemicals, excessive use of wetland resources, tourism, climate change, ete. Therefore, a study on wetland ecosystems is of priority concern and is the primary motivation of the present study.

In this study, the Kattampally wetland of Kannur district and the Biyyam wetland of the Malappuram district of Kerala were selected.

8) Pooja Purohit, Shubham maletha, Raj Singh, Himanshu Sahu (2025) - This study conducted a comprehensive assessment of water quality in the Asan wetland ecosystem from March to May 2023. The analysis focused on various physicochemical parameters to understand the current state of the ecosystem and its implications for overall health and functioning. The findings revealed that the water in the Asan wetland displayed a slightly alkaline pH, indicating a relatively neutral to slightly alkaline range. Dissolved oxygen levels were within favorable ranges for aquatic organisms, ensuring their survival and functioning. The analysis of biological oxygen demand (BOD) indicated varying levels of organic pollution across different sites, suggesting potential impacts on water quality and ecological well-being. The concentrations of various elements and ions exhibited spatial variation, influenced by geological characteristics, land use practices, and hydrological conditions. Additionally, the person correlation analysis identified significant relationships between different water quality parameters, providing insights into interdependencies within the aquatic ecosystem. This study contributes to our understanding of the current state of the Asan wetland and highlights the importance of ongoing monitoring and management practices to ensure its long-term health and sustainability. The United Nations Sustainable Development Goals (SDGs) emphasize the study's importance to broader global sustainability objectives.

9) Anuradha (2025)-The present investigation entitled "Assessment of quality parameters and economic valuation of Ramsar site wetlands in Himachal Pradesh" was conducted in the Department of Environmental Science during the year 2021-2023.The research aimed to evaluate the seasonal variability in physical, chemical and biological characteristics of water in Ramsar site wetlands of the Himachal Pradesh were determined by using standards methods. The soil health of catchments was also assessed and anthropogenic activities affecting wetlands were also identified. The study also evaluated the economic valuation of the wetlands, focusing on their direct use values by collecting primary and secondary data to calculate the revenue generated by wetlands annually. Wetlands water quality parameters like pH, Turbidity, TDS, DO, Alkalinity, Cl-, Ca2+, Mg2+, SO4 3-, TH, Na+, PO4 3-, NO3 ¯ and trace elements like Pb, Cr, Fe and Zn were assessed.

III. METHODOLOGY

A. Water quality index (WQI)

WQI is an extensively used method to categorize the water samples into different classes for beneficial use of domestic and drinking purposes. WQI is an arithmetic based process mainly depending on the assigned ranks and weights given to the analyzed elements based on the expert opinion and previous literature review of similar study. Based on this it is the most trustworthy technique for the evaluation of water quality and for comparative assessment of different water sources (Siraj et al., 2023). The complete evaluation of subsurface water importance and aptness was done by using the water analyzed parameters such as pH, EC, TDS, Ca, Mg, TH, Na, K, HCO_3, Cl, SO_4, and NO_3 were taken into consideration for WQI calculation. Table1. Physicochemical parameters, method used, and standards used / referred in present analysis for comparison:

Table 1.
Physicochemical Parameters

Sr. No.	Name of Parameters	Method / Instrument used	Procedure	Guideline Central Pollution Control Board (CPCB), India for sewer discharges-			Bureau of Indian Standards, (BIS).
				Inland surface water	Public Sewer	Land for irrigation	
1	pH	Digital pH meter (pH pocket sized Hanna and Elico LI 120)	pH meter calibrated at 4, 7 & 9.2 buffer tablet and direct used and noted direct values.	5.5–9.0	5.5–9.0	5.5–9.0	6.5–8.5

2	Temp (^{o}C)	A mercury filled centigrade thermometer	Mercury thermometer calibrated from 0 to 100 °C.	0 to 34 °C	0 to 34 °C	0 to 34 °C	< 25 °C
3	Turbidity (NTU)	Digital Nephelometric Turbidity meter	Turbidity measured by Turbidity meter.	–	–	–	10
4	EC (mS/cm).	Digital Conductivity meter	Elico conductivity meter	750–2000	750–2000	750–2000	–
5	TS (mg/L)	Filtration and weight difference of dish method.	Sample filtered through ordinary paper. Initial weight and final weight recorded. By weight difference method used for calculation of TS.	–	–	–	–
6	TSS (mg/L)	Filtration and weight difference of dish method.	Sample filtered through ordinary paper. Initial weight and final weight recorded. By weight difference method used for calculation of TSS.	< 100	–	–	–
7	TDS (mg/L)	Filtration and weight difference of dish method.	Sample filtered through ordinary paper. Initial weight and final weight recorded. By weight difference method used for calculation of TDS.	1500	500–2000	500–2000	500
8	Cl^{-} (mg/L)	Titration	Sample titrated against 0.02 M $AgNO_3$ solution using $K_2Cr_2O_4$ as an indicator.	1000	1000	1000	300

9	DO (mg/L)	Azide modification of Wrinklers method	Samples add 2 mL of alkali iodide azide, manganous sulphate and titrated with 0.025 N Sodium Thio-sulphate solutions with using starch as an indicator.	4	–	–	–
10	COD (mg/L)	Open reflux	Samples titrated with 0.1 ferrous Ammonium sulphate solutions with using ferroin as indicators.	250	250	250	–
11	BOD (mg/L)	Titration (3 day at 27 °C).	Calculated difference of initial and final dissolved oxygen in sample and titrated with 0.025 N Sodium Thio-sulphate solutions	30	350	100	100
12	NO_3 (mg/L)	Brucine method	Digest sample measured at 410 nm.	50	–	–	10
13	TH (mg/L)	EDTA Method	Erichrome black T used as an indicator and titrates against EDTA solution at the end point colour changes wine red to blue.	–	–	–	300
14	SO_4 (mg/L)	Gravimetric method	UV Vis Spectrophotometer	400	–	–	–
15	PO_4 (mg/L)	Titration	Elico SL-207 mini spec	5	–	–	0.05

pH is a quantitative measure of the acidic or alkaline nature of any aqueous solutions. It measures the hydrogen ion concentration in the aqueous solution. The pH scale ranges between 0 and 14 scales. The pH 7 is the neutral whereas the below 7 solutions being acidic and above 7 as alkaline

Temperature is an important physical parameter, and it can control the water chemistry and biochemical reaction in the organisms within the wetland ecosystem. It is one of the important factors since it promotes the development and spread of flora and fauna in the wetland environment (AM Abdel-Satar et al., 2017). It measures the average kinetic energy of water molecules and is measured in linear scale of Degree Celsius.

Turbidity is the amount of haziness in the water and measures in Nephelometric Turbidity Unit (NTU). The natural water bodies get silt, sand, clay, chemical precipitate, bacteria, germs, and organic decaying matter and which may lead to higher turbidity in water (Boyd and Boyd, 2020; Fahimah et al., 2023). The highest values may be caused by low water levels, higher temperatures, silt, clay, and suspended particles, while the lowest values may be brought on by silt and clay settling (Namdeo et al., 2013)

Electrical Conductivity – EC is an indicator of dissolved mineral concentration in water. The dissolved ions present in water are imparting the conductivity property to aqueous solutions (Puri et al., 2010). Electricity conductivity means the measurement of water capacity to conduct electricity. It is having unit of micro-siemens per centimeter.

Total dissolved solids- (TDS) are the results of many types of minerals that are present in the water. The dissolved oxygen (DO) is an essential parameter for maintaining a healthy water condition of wetland and for survival of aquatic organism in it (Kulkarni, 2016). The presence of higher dissolved oxygen level in water is a good indicator of a healthy water body and the absence of oxygen indicates water bodies get severely degraded due the pollution of it

COD is the amount of oxygen required for the oxidation of organic and inorganic materials present in water. The water mainly contains a different type of organic material, which does not get degraded by biological processes. In such cases organic or inorganic matter gets reacted with oxygen and gets oxidized gradually and converts it into oxides

Chloride is one of the important parameters of water characterization. The source of chloride in water resources is from surface runoff, cloth bleaching and vehicles washing, use of fertilizers, industrial/municipal solid wastes etc. Chloride containing salts is easily and rapidly soluble in water. Therefore, it can get entered in ground and surface water rapidly from the disposed salts.

IV. CONCLUSIONS

Wetlands are integral components of the global ecosystem, offering numerous ecological, hydrological, and socio-economic benefits. However, increasing anthropogenic pressures such as rapid urbanization, industrialization, agricultural runoff, and indiscriminate waste disposal have significantly deteriorated wetland water quality. This review synthesizes findings from numerous research studies focused on the physicochemical analysis of wetland water, highlighting the importance of regular monitoring to evaluate the status and trends in water quality.

Across the reviewed literature, the commonly studied water quality parameters include pH, temperature, turbidity, electrical conductivity (EC), total dissolved solids (TDS), total hardness (TH), chlorides, nitrates, phosphates, biological oxygen demand (BOD), chemical oxygen demand (COD), and dissolved oxygen (DO). These parameters are critical indicators of pollution levels, aquatic health, and the potential usability of water for drinking, irrigation, and aquatic biodiversity conservation. In particular, high BOD and COD levels, combined with low DO content, are clear indicators of organic pollution and poor water quality

In conclusion, immediate and sustained efforts are needed to safeguard wetland ecosystems. Regular water quality assessments, combined with pollution mitigation strategies, community involvement, and strict enforcement of environmental regulations, are crucial for preserving the ecological integrity of wetlands. These findings should inform future wetland restoration projects, guide policy interventions, and support the achievement of Sustainable Development Goals (SDGs), especially those related to clean water, ecosystem health, and climate action.

A. Preventive Measures

1) Periodic removal and disposal of weeds from the lake.
2) De-silting of the lake in the selected areas in regular intervals.
3) Construction of silt traps and constructed wetlands at the entry of incoming drains and sewage.
4) Strengthening/ formation of bund.
5) Providing chain link fencing for protection of lake.
6) Prevention of pollution from point sources by intercepting, diverting and treating the pollution loads entering the lake.
7) Catchment area treatment and lake front Eco- development which may include bunding, fencing, and shore line development, creation of facilities for public recreation and entertainment (Children Park, boating etc.) and public area.
8) Public awareness and public participation through formation of committees with local people.
9) Other activities depending upon location specific conditions including the interface with human population.

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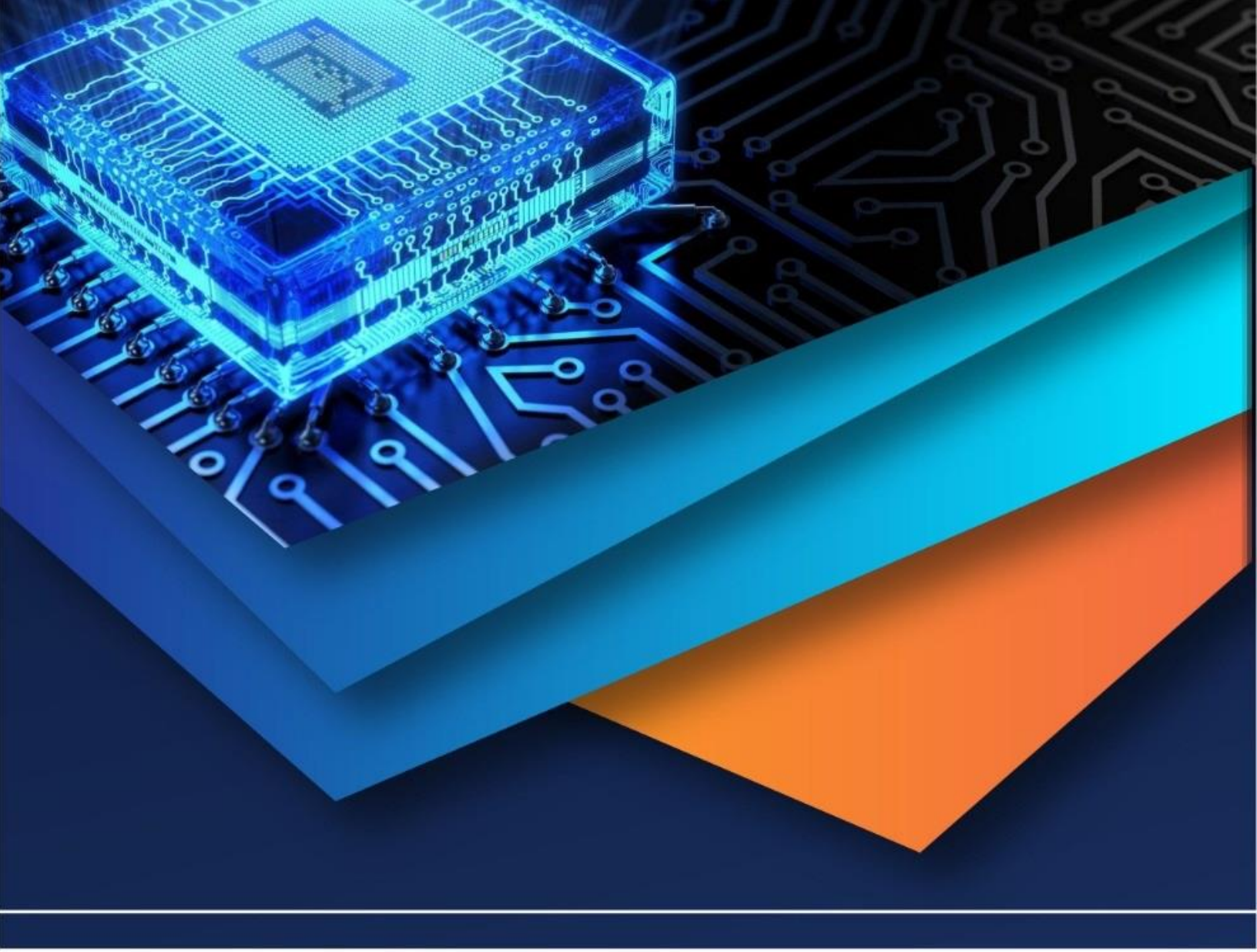

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