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Assessment of Water Quality of Manohara River Kathmandu, Nepal

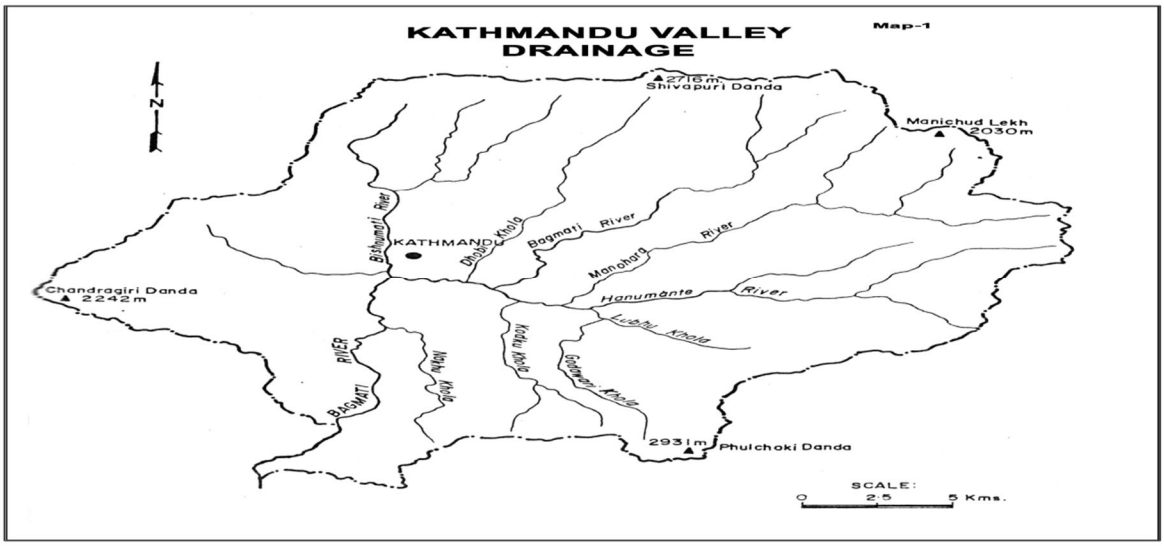
N. Mohendra Singh[1], Kh. Rajmani Singh[2]
[1, 2]*Department of Zoology, Dhanamanjuri University, Imphal*

Abstract: The present works focus on the physico-chemical and biological assessment of water carried out on the five segment at the river over a stretch of 22.5km. On the five segment of the river-temperature p^H, transparency, dissolved oxygen, biochemical oxygen demand carbon dioxide, chloride, total alkalinity, acidity, calcium hardness, nitrate and nitrites etc. increased at down stream segments as scored into intermediate category showing more pollution and environmental deterioration compare to other upstream segments where as dissolved oxygen decreases at down streams. Eleven species of fish, seven group of aquatic insects, one group of annelids were recorded, snake head fish were also observed. Excavation of excessive amount of sand from the river, encroachment of flood plains and bars, solid waste and sewage effluent and tendency of land use changed retards environmental degradation of Manohara river from human activities. An attempt has been made coefficient correlation between the parameters and aquatic fauna.

Keywords: Physico-chemical, parameters, Manohara river, Aquatic life, correlation.

I. INTRODUCTION

Rivers are natural resources which have ecological and recreational functions. People mostly depend on rivers for agricultural and domestic purposes. Many temples and crematories located around the river have increased cultural values of the river. Nutrient carries such as nitrogen phosphorus and organic matters are the most important compound regulating biological productivity of water bodies and their cycle are the basis for management of fish culture. However, with rapid growing population and urbanization, escalating industrialization and agricultural activities have brought irreversible changes ecological and different activities like unplanned building and encroachment, clearing of riparian vegetation along the river banks, disposal of waste materials in the river and unwise mining of construction materials from the rivers are commonly observed in rivers of Kathmandu valley. Human as well as natural phenomena are responsible for bringing disturbances in the river system because many people depend on water of the Manohara river. Degree of pollution estimates either from physical and chemical characteristics of water or biochemical characteristics of water. UNESCO world heritage sites. Changunarayan Temple and other places such as International Airport, Sali Nadi Temple and Nilbarahi Temple are located around the river. Thus present work has been established. The present work reveals biochemical assessment of the Manohara river as one of the most important feeder of Bagmati river. The river starts from Saranchowk valley of Sankhu end at Koteshowr (Kathmandu) where it joins the Bagmati river with the length of 22.5km from its start to end.



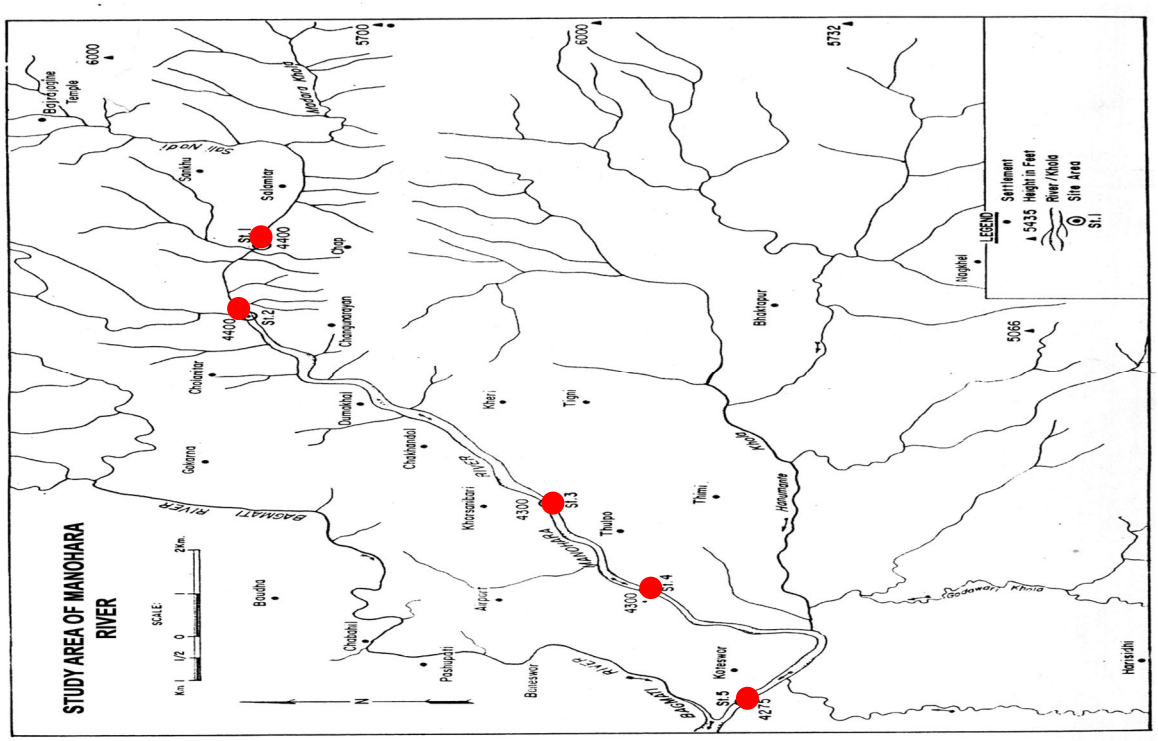
II. MATERIAL AND METHODS

The area selected for present study Manohara river flows toward south east direction i.e. towards the centre of Kathmandu valley without making any distinct meander feature at the border of Kathmandu district Bhaktapur district with the main sources of Sali-nadi and Madara Khola, this two rivers join at Galsuli village flows as Salinadi until reaches Saranchowk village where it joins with Manamata Khola known as Manohara river. In between many small and big tributaries like Manamote khola (Saranchowk) Mahadev Khola (Brahmakhel) and Hanumante Khola (Patan) passing thorugh Manohara, Koteshowr and Phulbari respectively, with the length of 22.5km. disturbing the environment mostly truck crosses, dredging activities, forest land has been converted to cultivated land and settlement area. River bank is covered with sand and few vegetation. People do not use chemical fertilizers to very much amount for crops due to bad economy condition. With these view five sampling station were selected in the town reconnaissance survey of the river on the basis of the number of tributaries, joining the main streams, distances, human activities etc. Thus, the present study has made five station (Table -1), sampling at interval of every month from June to November, 2019 in different sampling stations of Manohara River. An attempt has been made to find out the correlation between physico-chemical parameters of water and fish fauna along with benthic fauna of the river.

Table - 1

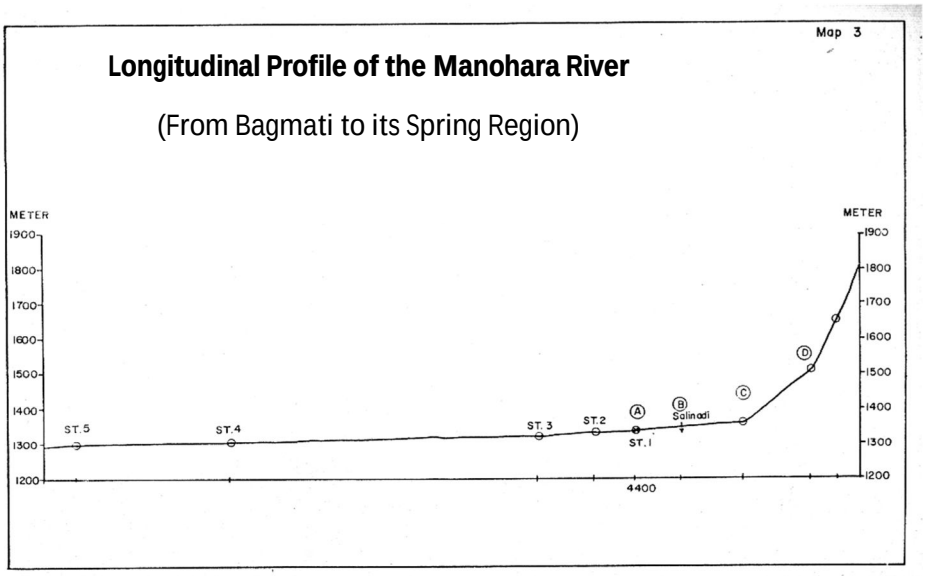
Station 1	Segment	Attitude (m)
1	Saranchowk	1321.32
2.	Brahmakhel	1321.32
3.	Manohara	1291.28
4.	Koteshowr	1291.28
5.	Phulbari	1283.78

The physical analysis of water was done on sampling site itself. The samples were brought to the laboratory in chilled condition. The physico-chemical characteristics of water were estimated by standard procedure (APHA, 1995) the fishes were collected from the study sites with the help of local fisherman by using different techniques. Collected fishes were analysed after (Shrestha, J. 1985) Jhingran (1995) (Viswanath, W, 2002) while aquatic benthic fauna were analysed after Ward and Wipple (1995). Correlation of physico-chemical parameters of water with fish and other aquatic insects distribution method followed by Cox (1981), Gupta (1982) Karl Pearson (1991.



III. RESULT AND DISCUSSION

Temperature is an important parameter to get an idea of self purification of river and play an important role in aquatic ecosystem. In Manohara river the highest temperature was recorded as 30^0C during September and lowest temperature was recorded as 10^0C during November (Table-3). Increased temperature not only reduces oxygen availability but also increases oxygen demand, a situation that would add to the physiological stress of organisms (Giller and Matmquist, 1998). The current velocity of water ranged from 0.58-0.80m/sec. Depth of water was recorded 3cm as minimum and 60cm recorded as maximum, width of the water surface was measured and recorded between 3-8m. as lowest and highest respectively. Transparency was measured with Secchi-disc (20 cm diameter) and recorded highest as 28.5cm and lowest recorded as 9.0cm. All values recorded above fall within the permissible limit prescribed by ICMR (WHO). Transparency/Turbidity has been considered as a limiting factor for biological productivity in fresh water (Kausik and Saxena, 1999). The sources are mainly the streams water, agricultural run off and effluents from industrial and domestic sectors which in turn restrict the penetration of light, giving rise to reduced photosynthesis and esthetic unsatisfactory odours. (Kiran, Ramchandra, 1999) p^H value recorded from 6-7.8 as lowest and highest in the month of October and November data supported by DHM (2005). P^H value recorded in the present study within the desirable limit prescribed by ICMR (WHO). P^H range of 6.7-8.4 is considered to safe for aquatic life and maintain productivity. However, p^H below 4.0 and above 9.6 is hazardous to most life forms. P^H gives an idea to the type ad intensity pollution (Mishra and Saxena, 1991). Dissolved oxygen observed as 10.3mg/L at the upstream region of the river as highest value while the lowest value as 5.2mg/L at the downstream of the river in the month of November and July respectively suggested content is related to pollution with sewage faecal and detergents which perhaps had affected oxygen concentration. Increase in DO related to decrease in temperature or decrease in DO possibly because of higher temperature as solubility of oxygen decreases with increase temperature. Highest DO recorded during monsoon and post monsoon months may be due to impact of rain water resulting in aeration, Hannan (1979), Jebansel *et al.* (1987), Abbasi etal (1997), Mathew Koshy and Nayar (1999).



Organic matter present in water utilize the DO of water for its decomposition, depletion of oxygen and makes difficult for biota to live in heavily loaded water body. During the study period in Manohara river the highest BOD was recorded as 8.0 mg/L in November and lowest recorded as 1.0 mg/L in the same month of different sampling site 3 and 4 (Manohara) and (Koteshowr) respectively. A relative oxygen demand is the amount of oxygen required for the biochemical degradation of organic materials such as sulfides and ferrous ions (APHA, 1985). The present value observed in the Manohara river revealed more pollution at the downstream compare to upstream regions. The data is supported by Clair N. Sawyer *et al.* (2003) as reported BOD level 6-9 mg/L considered some what polluted because usually organic matters present and bacteria are decomposing these waste. Total alkalinity of the water sample ranged between 40-95mg/L during the month of October and September respectively at the same sampling station 5 (Phulbari) down stream. Analogous variation in total alkalinity was supported by Goel *et al.* (1985). The increase of alkalinity content might be due to the fact that the accidental mixing of the amount of industrial substances in low water quality and high evaporation rates, change in alkalinity might be due to increased decomposition. Similar observation was also reported by

Hedge and Bharathi (1989).Tank or pond fish water p^H highly basic or alkaline and can chap or chemically burn fish skin. Young fish more sensitive to higher acidic water than adult fish. P^H 5 is too acidic and kill off fish egg, and not hatch, Myer, Rollie. J (2010). Acidity content recorded between the range 5-28mg/L as minimum and maximum during August and November respectively. Highest value observed at downstream. The present recorded value was supported Mishra and Saxena (1991). Free carbon dioxide content was recorded as 10 mg/L and 25mg/L during the month of September and November as minima & maxima respectively. Increasing free carbon dioxide may result increasing of alkanility, Bargava *et al.* (2005). Chloride content in the water ranged from 3-15mg/L. According to WHO maximum limit of chloride is 500mg/L. The present value observed below the permissible limit. Nitrate and Nitrite was generated by heterotrophic microbes as primary end products of decomposition of organic compound, Wetzel (1983). Presence of excessive nitrate in water due to man made domestic activities and fertilizers from agricultural field, Zutchi and Khan (1998). During study nitrate and nitrite observed 0.3-0.4 mg/L and 0.01-0.40 mg/L respectively. Variation analogous was supported by Devi *et al.* (2003). During investigation period three hundred samples were taken, four hundred sixty five fishes were noticed and one thousand eight hundred eighty nine aquatic insects were counted percentage and distribution of fish and benthic fauna in the Manohara river shown in (Fig. 1 & 2). On the basis of substantial availability of above observation statistical analysis of coefficient correlation and probable error between the aquatic fauna and physico-chemical parameter was made, (Table 4 and 5). Surprisingly, the present assessment of water quality of Manohara river recorded different from the past environment of the river had been drastically changed from the study by author in the year of 1993, water quality has been deteriorating condition supported by Tamrakar NK (2004). Thus, the need of the hour is to monitor and motivate the people of the catchment areas as well as systematic routine analysis of water is urgent required for monitoring water quality. For this immediate actions, local Govt. local club organization, NGOs Nagarpalika members/ Panchayat samity and other voluntary organisation should be gear up by fishery department with the cooperation of Government with seriously to conserve the river water. Random effluent dumping must be banned, proper treatment and unauthorized letting out of these effluent on the water surface should be checked without any delayed is the immediate task for everyone. If the present disturbances in the river is continued in the current trends there will aggravate system and instability will bring undiscoverable deteriorable into the river. Eleven Species of fishes collected from the present study area shown in Table – 2, from June to November, 2019

Table – 2

Order	-	Cyprinoformes
Sub-order	-	Cyprinoidei
Family	-	Cyprinidae
Sub-family	-	Cyprinini
Genus	-	*Barilius* (Hamilton)
Sp.	-	1. *B. vagra* (Hamilton)
Genus	-	*Garra* (Hamilton)
Species	-	2. *Garra. annandalei* (Hora)
		3. *Garra. gotyla* (Gray)
Genus	-	*Puntius* (Hamilton)
Sp.	-	4. *P. appogon* (Cuv. Val)
		5. *P. chola* (Hamilton)
		6. *P. sarana* (Hamilton)
		7. *P. sophore* (Hamilton)
Genus	-	*Esomus* (Swainson)
Sp.	-	8. *E. danricus* (Hamilton)
Order	-	Channiformes
Family	-	Channidae
Genus	-	*Channa* (Gronovicus)
Sp.	-	9. *Channa gachua* (Hamilton)
		10. *C. Punctatus* (Bloch)
Family	-	Saccrobranchidae
Genus	-	*Heteropneustes* (Muller)
Sp.		11. *H. fossilis* (Bloch)

Table – 3

Parameters	June	July	August	Sept.	Oct.	Nov.
Temp ^{0}C	28.1±2.6	22.8±1.5	26±1.3	27.3±2.4	17.3±1.3	13.6±1.6
Transp. (cm)	20.3±2.3	21.1±6.6	26.5±7.0	16.7±4.1	---	---
pH	6.9±0.4	2.1±0.8	7.5±0.3	7.4±0.5	5.8±0.03	7.7±0.8
D.O (mg/L)	7.7±2.0	7.0±1.0	6.8±0.7	6.5±0.6	8.3±0.9	9.2±0.2
BOD (mg/L)	2.3±1.4	3.1±1.0	2.6±0.8	1.8±0.7	4.4±1.8	4.1±2.3
Total alkalinity	42.7±22.4	41.4±17.2	66±14.2	59±1.6	46±17.6	50±14.3
Acidity	14.5±1.2	9.6±1.4	8.0±2.9	9.3±1.2	18±4.0	17.2±4.2
CO_2	13.5±1.0	8.4±1.2	7.9±3.4	9.2±0.9	15.0±4.1	11.9±1.0
Chloride	5.2±1.2	5.5±1.8	11.7±1.0	10.0±1.5	10.0±1.5	32.6±1.0
Total Hardness	26.9±3.1	27.0±2.0	29.01±19.2	33.0±19.2	34±27.0	8.10±4.2
Calcium	7.3±0.9	10.4±1.3	9.7±6.0	8.5±4.8	11.5±8.6	0.01±0.17
Nitrite	0.08±0.03	0.07±0.04	0.06±0.03	0.03±0.18	0.01±0.1	0.13±0.16
Nitrate	0.12±0.02	0.09±0.03	0.05±0.03	0.08±0.04	0.09±0.08	0.13±0.16

Table – 4

Correlation between some physico-chemical parameters of water and no. of fish

Sl. No.	Parameter	r	r^2	PEr
1.	Temperature	+0.247	+0.062	+0.2586
2.	Tubidity	+0.567	+0.321	+0.2586
3.	Current Velocity	– 0.138	+0.276	+0.1993
4.	Depth	+0.168	+0.028	+0.2676
5.	P^H	+0.404	+0.108	+0.2304
6.	Dissolved Oxygen	–0.077	+0.005	+0.2739
7.	Free CO_2	-0.883	+0.146	+0.2351

Table – 5:

Correlation between some physico-chemical parameters of water and other aquatic insects

Sl. No.	Parameter	r	r^2	PEr
1.	Temperature	– 0.023	0.0005	0.2751
2.	Tubidity	– 0.131	0.0171	0.2706
3.	Current Velocity	– 0.001	---	0.2753
4.	Depth	– 0.902	0.813	0.0513
5.	P^H	– 1.170	0.025	0.2673
6.	Dissolved Oxygen	+ 0.214	0.045	0.2627
7.	Free CO_2	+ 0.436	0.1900	0.2300

IV. ACKNOWLEDGEMENT

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DISTRIBUTION OF FISHES IN MANOHARA RIVER (%)

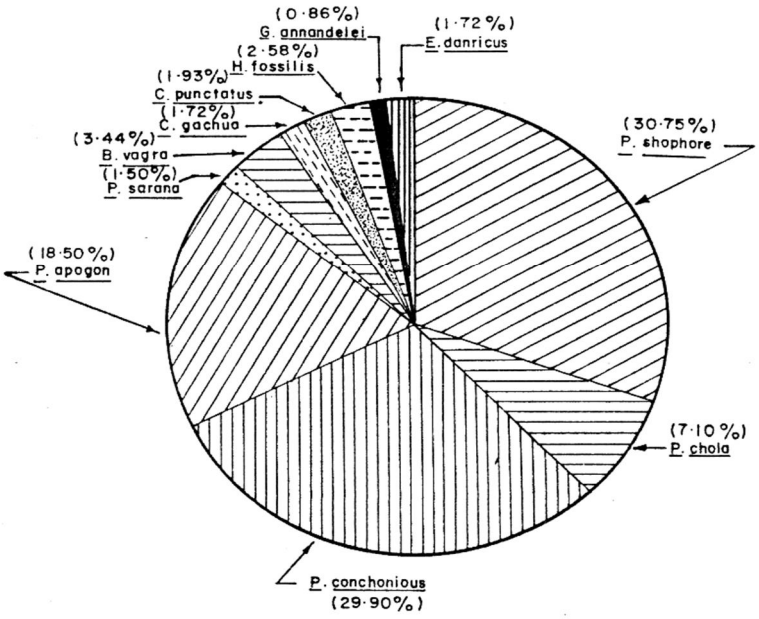

Fig. 1

DISTRIBUTION OF FENTHIC FAUNA IN MANOHARA RIVER (%)

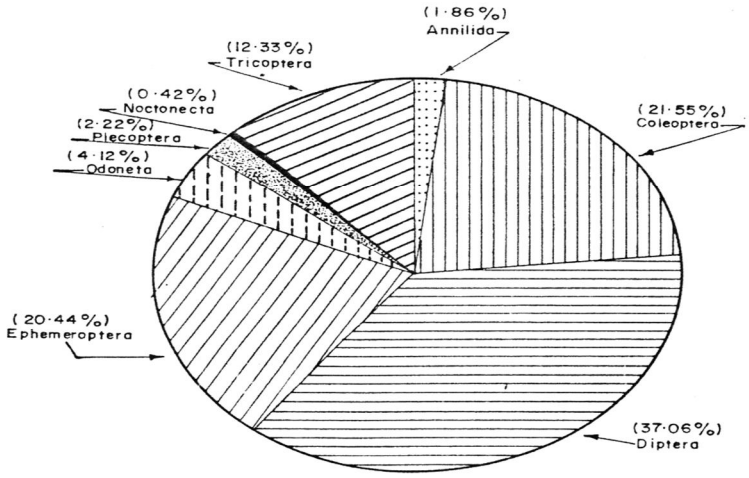

Fig. 2

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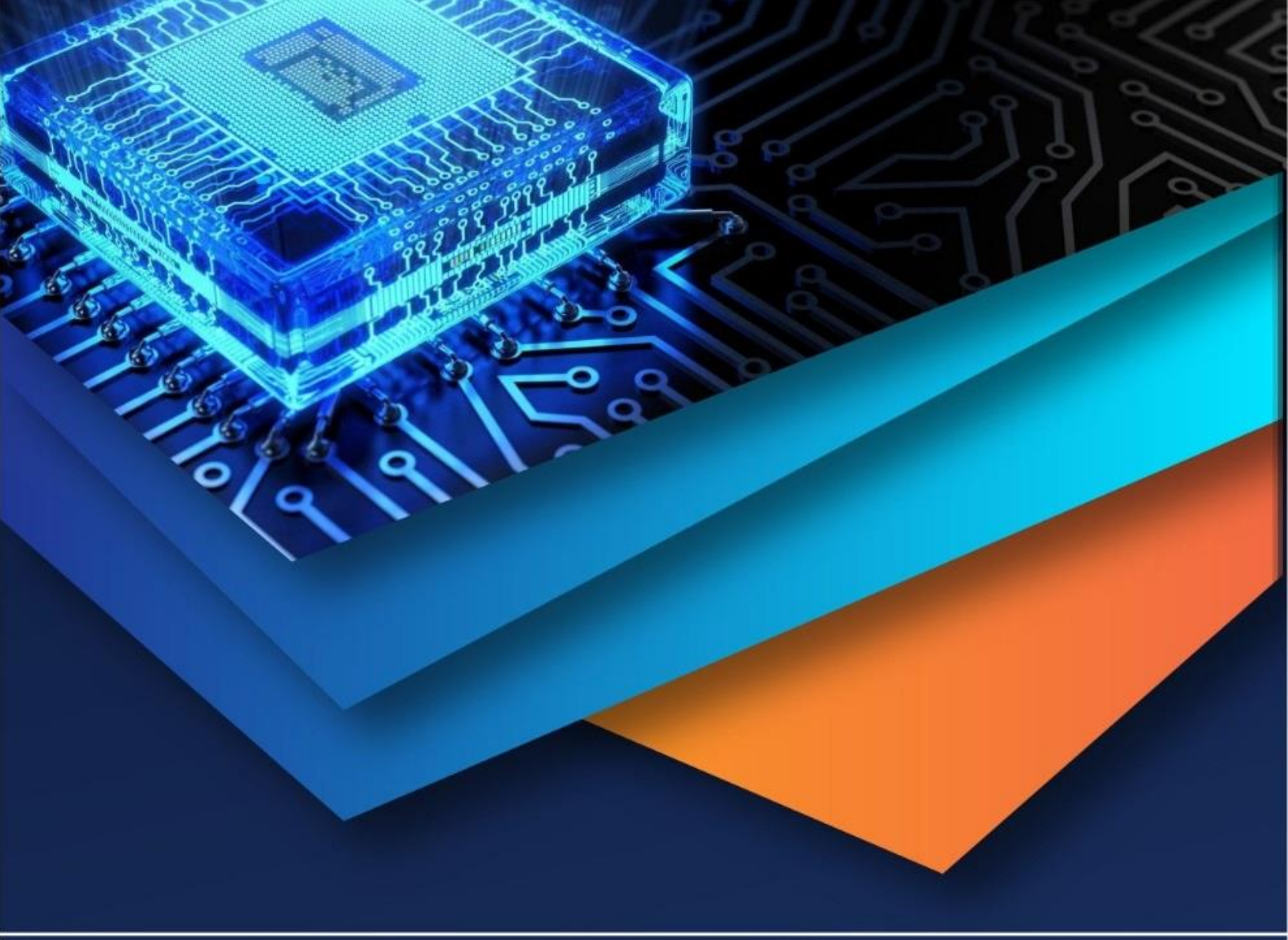

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