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Bhumi Pareeksha (Analysis of Soil) at *Charak Upvan* (Amberi,Udaipur) WSR to Cultivation of Medicinal Plants

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Abstract: Bhumi Pareeksha, i.e elaborated study of land is one of the former techniques adopted by our ancestors before growing any kind of food on it. It is done here at Charak upvan, our college garden placed close to Amberi, Udaipur in anticipation of the ongoing model nursery project for medicinal plant cultivation. Soil testing in this area is done with both Ayurvedic aspects to know Mahabhoot predominance, Rasa predominance, etc, and modern aspects to ascertain the mineral contents of the soil and calculate the requirement of fertilizer dose for the cultivation of Shweta musali. An attempt is done for a thorough study of the soil which will pave way for better quality yield of medicinal plants in the respective area.

I. INTRODUCTION

Bhumi pareeksha in Ayurveda is one among the *Dashavidha pareeksha* where *Desha pareeksha* may be taken as either *Aatur deha pareeksha* or *Bhumi sthaan pareeksha*. "Jignyasa Naam pareeksha" the quote by Acharaya Charak denotes whenever there is curiosity regarding anything, it can only be answered by *Pareeksha* or examinations or analysis of the things related. Investigations done extensively and the establishment of fact is termed as *pareeksha*. Hence, it is of utmost importance to have complete knowledge and understanding of the field before desiring outcome from it. The whole concept of *pareeksha* is utilized herein context of *Bhumi pareeksha* for analysis of soil by the collection of the soil sample from Charak upvan, the college garden situated in the Amberi region of Udaipur. Soil testing is mainly done for the measurement of the elements present in it and presents the array of required nutrients for the cultivation of the medicinal plant, Shweta musali i.e Cholophytum borivilianum in that area. Earlier no such attempts were made in this direction though many medicinal plants are cultivated as well as growing wild in this area. An effort has been made to interpret the soil from both Ayurvedic as well as modern aspects.

II. MATERIAL AND METHODS

1) Collection of soil sample which represents the selected field.
2) Gross analysis of the sample from the Ayurvedic perspective.
3) Laboratory tests of the collected soil sample.
4) Utilise this information for estimation of appropriate nutrient requirements of the soil for the cultivation of Shweta musali.

A. Collection of soil sample[1]

Soils can be highly variable, even over short distances. Because of this variability, it is often inappropriate to collect soil from just one location. Instead, it is preferable to collect so-called composite samples. Composite samples are a mixture of individual samples, or sub-samples, generally collected from multiple locations and mixed to form a single composite sample. By combining multiple sub-samples into a single composite sample, we can minimize the effects of soil variability by averaging the soil properties over larger areas. Composite samples are less sensitive to unusually high or low soil test values that might occur due to concentrated fertilizer applications (e.g. banded applications) or natural soil variation

The soil sample is collected from the determined area for the cultivation of Shweta musali. From the desired area 5 sub-samples were collected from random areas and mixed. In each collection, the soil was dug from 15-20 cm depth with the use of a spade after removal of surface soil. Overall 4 kg of sample was collected which was reduced to half kg of the homogenous mixture by mixing the whole sample, dividing it into 4 parts, discarding the opposite half, and keeping the other opposite half.

1) Collection of 5 sub-samples - from different location of the selected field area.
2) Mixing of all the collected sub-samples which approximately weighed around 4 kg
3) The mixed sample is divided into 4 parts
4) The opposite half is discarded.
5) The other opposite half is kept.
6) The same procedure is repeated until we get a reduced half kg of homogenous mixture.

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B. Analysis Of The Sample From The Ayurvedic Perspective

Acharyas have classified the land as follows[2] –

1) *As per Mahabhoot dominance*[3]*: Acharaya Charaka* says, "*Sarvam dravyam panchbhautikam asminarthey*" which means every object in this world is *panchbhautik* i.e. made of *panch mahabhootas.* Similarly, *bhumi* is also *panchbhautik* but depending on specific place and major contribution of any of the specific *mahabhoot* makes it of particular *mahabhoot.*

As per *mahabhoot* dominance, *Acharaya Sushruta* and *Raj nighantukara* has classified *bhumi* as five types-

a) *Parthiva Bhumi:* The stable land which is full of stones and concrete with heavy black colored soil and mostly huge trees is known as *Parthiva Bhumi.*
b) *Aapya Bhumi:* The unctuous and cold land with unctuous and tender plants growing generally in white colored sandy soil is termed as *Aapya Bhumi*
c) *Aagneya Bhumi:* The land with different colors of concrete lightweight soil and generally some light colored trees is *Aagneya Bhumi.*
d) *Vaayvya Bhumi:* Dry land with ash-colored soil and small, dry trees with low water content is *Vaayvya Bhumi*
e) *Nabhsi Bhumi:* Land with soft uniform soil where trees are generally of indistinctive taste uniformly grown all over is *Naabhsi Bhumi.*

2) *As per Shadrasa*[4]*:* Depending on *Madhuradi* six tastes, *Bhumi* is also classified into six types-

a) *Madhura bhumi*
b) *Amla bhumi*
c) *Lavana bhumi*
d) *Katu bhumi*
e) *Tikta bhumi*
f) *Kashaya bhumi*

3) *As Per Soil Quality and Texture: Raj Nighantukara* has classified *Bhumi* under five types depending on soil[5]-

a) *Urvara bhumi*
b) *Kshaar bhumi*
c) *Sharkara bhumi*
d) *Krishna bhumi*
e) *Pandu bhumi*

- *Urvara Bhumi*

Sa Bhoomirurvarakhya ya sarvashashyodbhavprada
Samastavastudbhavanadurvara naam bhuriyama

The land which is capable of cultivating all the plants is known as *Uvara Bhoomi.* In short, we can call it fertile land.

- *Sharkara Bhumi*

Sa Sharkarah Sharkarilo desho yaha sharkaranvitaha
Sekatah syaat siktilaha siktavaansh yo bhavet

The land composed of granules or pebbles or sand is known as *Sharkara Bhumi.*

- *Kshaariye Bhumi*

Kshaara mrudusharo deshasthadvanirnamushram
Khilamprahatam prahurdhanva tu maruruchyaye

The land with alkaline soil is known as *Kshaariye Bhumi.*

- *Krishna Bhumi* and *Pandu Bhumi*

Krishnamrut krishnabhumi syaat pandubhumistu pandumrut

The land with black soil is known as *Krishna Bhumi* whereas the land with white-colored soil is called *Pandu Bhumi*

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4) As Per Caste: Raj Nighantukara has also classified *Bhumi* according to castes as[6]-

Kshetra bhedam pravakshami Shivenakhyaatamanjsa /

Brahman Kshaatram cha Vaisheeyeya Kshaudram cheti yatha kramath //

a) Brahman Kshetra: Plants are enormously grown in this area, Such region never face scarcity of water, it is always occupied by lush green grass, it's pleasant and has white-colored soil.

b) Kshatriya Kshetra: The region having copper-colored soil, which is a residential place for wild animals and devoid of *Khadiradi* plants is known as *Kshatriya kshetra.*

c) Vaishyey Kshetra: The land which is shining as bright as gold, composed of gold-like sand particles, which is always beneficial and at the same time praised by *Siddhas, Kinnara,* and *Deva Gandharvaadi* is termed as *Vaishyey kshetra.*

d) Shudra Kshetra: *Shudra kshetra* is the one which consists of slightly black-colored soil, capable of giving high yield, decorated with widely spread grasses, *Babool* like trees are often grown enormously here, and makes the cultivators blissful with satisfying yields.

5) As Per the Color of the Soil: Varahamihira has classified *bhumi* in 4 types depending on the color of the soil-

a) Shweta Bhumi: Color of the soil is ash-colored white in *Shweta Bhumi.*

b) Rakta Bhumi: Rakta Bhumi possess red-colored soil.

c) Peeta Bhumi: The land with somewhat yellow colored soil is known as *Peeta Bhumi.*

d) Krishna Bhumi: Krishna Bhumi is the land with black colored soil.

As per these classifications, soil sample of *Charak upvan* can be classified as follows-

Mahabhoot dominance	Parthiva bhumi	Aapya bhumi	Aagney bhumi	Vaayvya bhumi	Nabhsi bhumi	-
	+	-	-	-	-	
Shadrasa	Madhura bhumi	Amla bhumi	Lavana bhumi	Katu bhumi	Tikta bhumi	Kashaya bhumi
	-	-	-	-	-	+
Soil quality and texture	Urvara bhumi	Sharkara bhumi	Kshaar bhumi	Krishna bhumi	Pandu bhumi	-
	-	+	-	-	-	-
Caste	Brahman kshetra	Kshatriye kshetra	Vaishya kshetra	Shudra kshetra	-	-
	-	-	-	+	-	-
Colour of soil.	Shweta bhumi	Rakta bhumi	Peeta bhumi	Krishna bhumi	-	-
	-	-	-	+	-	-

C. Laboratory Tests Of The Collected Sample

The final sample was given for testing at the Soil testing laboratory, Department of soil science & Agricultural chemistry, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur.

Methods followed for soil analysis were as follows-

Sr. No.	Determination	Methods followed	References
I	Physical determination-		
1	Bulk density (B.D.)	Undisturbed core sampler method (7.5 cm diameter and 8 cm height)	Singh (1980)
II	Chemical determinations-		
1	Soil reaction (pH)	Using pH meter in 1:2 soil water suspension as per method of USDA, Handbook No. 60	Richard's 1954
2	Electrical	ECe was measured with the help of	Richard's 1954

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	conductivity (EC)	"Solubridge" in soil saturation extract as per the method 4b, USDA, Handbook No. 60	
3	Organic Carbon	Walkey and Black's rapid titration method	Walkey and Black, 1934
4	Available nitrogen	By alkaline permanganate method.	Subbiah and Asija (1956)
5	Available Phosphorus	Extraction of the soil with 0.5 M $NaHCO_3$ at pH 8.5 and development of blue color with $SnCl_2$ and measurement through colorimetrically	Olsen et al. (1954)
6	Available Potassium	Extraction was done with 1 N neutral ammonium acetate at pH 7.0 and determined by flame photometer.	Merwin and Peech (1951)
7	Available Zn, Fe, Mn, Cu, Pb, Ni, and Cr	Analysis of suitable aliquot of DTPA extract with the help of atomic absorption spectrophotometer (Varian techtron AAS-120)	Lindsay and Norvell (1978)

The Significance of the above tests are as follows-

1) *Physical Determinations*

a) *Bulk Density:* Bulk density reflects the soil's ability to function for structural support, water and solute movement, and soil aeration. In short, it is the weight of soil in a given volume of soil. Soils with a bulk density higher than 1.6 g/cm^3 tend to restrict root growth.

2) *Chemical Determinations*

a) *Soil Reaction (pH):* Soil pH is important because it influences various soil factors affecting plant growth such as soil bacteria, nutrient leaching, nutrient availability, toxic elements, and soil structure. Plant nutrients are generally most available to plants in the pH range 5.5-6.5. There is a different requirement for different types of plants like some need acidic environment whereas some grow well in alkaline while some require neutral pH.

b) *Electrical Conductivity (EC):* Soil electrical conductivity is a measure of the amount of salt in soil i.e. salinity of the soil. It is an important indicator of soil health. It affects crop yields, crop suitability, plant nutrient availability, and activity of soil micro-organisms. EC levels can serve as an indirect indicator of the amount of water and water-soluble nutrients available for plant uptake such as Nitrate-N.

c) *Organic Carbon (C):* Estimates of total organic Carbon (Expressed as C) are used to assess the amount of organic matter in the soil. It measures the quantity of carbon in plants and animal remains, along with soil humus however not charcoal or coal. Higher soil organic C promotes soil structure i.e. there's larger physical stability. It improves soil aeration (O_2 in soil), water drainage, retention, and reduces the risk of erosion and nutrient leaching.

d) *Available Nitrogen (N):* It is nitrogen in a chemical form that can be readily absorbed by plant roots. Testing soil for nitrogen has been a useful practice in the drier regions of the great plains for many years.

e) *Available Phosphorous (P):* The availability of Phosphorous is considered to be a fairly good indicator of P supplying capacity of the soil. Soil test estimates the amount that is available to plants during the growing season since P is the constituent of plant cells, essential for cell division and development of the growing tip of the plant.

f) *Available Potassium (K):* Soil test for potassium is the best management tool for predicting the amount of potassium needed in a fertilizer program. K is essential to plant nutrients and is required in large amounts for proper growth and reproduction of plants.

g) *Available Micronutrients:* Micronutrients are elements essential to plants that are required in very small amounts. Out of these, iron, manganese, zinc, and copper are tested routinely. Micronutrient deficiencies are most likely to occur in sandy, low organic matter soils.

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h) Available Zinc (Zn): Zinc aids in plant growth and is needed in producing chlorophyll. It also improves root development, flowering, and fruit production.

i) Available Iron (Fe): Iron is important for electron transport in some enzymes. It is also associated with enzymes in chlorophyll production.

j) Available Manganese (Mn): It is the constituent of respiratory enzymes and involved in oxidation/reduction in photosynthesis. Mn accelerates germination and maturity and it is indirectly related to chlorophyll production.

k) Available Copper (Cu): It is a constituent of oxidase enzymes and the metal component of some proteins which helps with electron transfer. Cu present in the soil is often bonded to organic soil molecules like humic and fulvic acids and most importantly it does not move with mass flow or water movement. The soil test values are compared to levels normally found in Northeast soils. When levels are well below this range, there is a recommendation for collecting a plant tissue sample to determine if a deficiency exists and a micronutrient fertilizer is required.

l) Available Lead (Pb): Lead is naturally present in all soils. It generally occurs in the range of 15 to 40 parts lead per million parts of soil while pollution may increase soil lead levels to several thousand ppm.

m) Available Nickel (Ni): Nickel availability in the soil varies as a function of pH. Plants require Ni in small quantities for normal development.

n) Available Chromium (Cr): Chromium levels in soil vary according to area and degree of contamination from anthropogenic chromium sources.

High soil pH may also bring about micronutrient deficiencies, especially in sandy soils. Micronutrient deficiencies and response to micronutrient fertilizers are rarely observed in the Northeast. For this reason, optimum ranges have never been defined.

Results of conducted tests are-

Sr. No.	Determination	Result
I	Physical determination-	
1	Bulk density (B.D.) (Mg cm^{-1})	1.11
II	Chemical determinations-	
1	Soil reaction (pH)	8.29
2	Electrical conductivity (EC) (dS/m)	0.15
3	Organic Carbon (%)	0.68
4	Available nitrogen (kg/ha)	468.93
5	Available Phosphorus (kg/ha)	22.27
6	Available potassium (kg/ha)	276.90
7	Available Zn (ppm)	11.48
8	Available Fe (ppm)	21.62
9	Available Mn (ppm)	26.44
10	Available Cu (ppm)	12.36
11	Available Pb (ppm)	10.54
12	Available Ni (ppm)	2.36
13	Available Cr (ppm)	0.276

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D. Determination of Appropriate Nutrient Requirements of the soil for the cultivation of Shweta musali

Shweta musali are often cultivated on various types of soils from sandy loam, sandy clay, low in organic matter and acidic soils of Bihar, West Bengal to heavy black cotton soils of Maharashtra, Madhya Pradesh, Andhra Pradesh to red lateritic soils of Karnataka to calcareous soils of Gujarat and Rajasthan. However, crop prefers well-drained loamy soils rich in organic matter for good fasciculated root development and high productivity. Soils with high pH and high calcium carbonate content are not suitable for the crop and show severe micro-nutrients deficiency symptoms especially for iron and cause chlorosis[7].

The utilization of organic manures like farmyard manure, compost, vermicompost, poultry manure, and green manure are preferred for growing medicinal plants. However, mineral nutrition can also be supplemented through inorganic sources considering the need of the crop. Application of 15-tonne farmyard manure along with 50:40:40 kg NPK per hectare found optimum for obtaining an honest yield of *Shweta musali*. Higher doses of fertilizers have a deleterious effect on roots. Among micronutrients, iron deficiency is most prevalent in *Shweta musali*. Green manuring with cowpea in summer may help in minimizing iron deficiency and improving crop productivity

III. DISCUSSION

The need for evaluation of soil at Charak Upvan generated with the thought of cultivating medicinal plants in this area with the ongoing Model Nursery Project of our college. Since better yield are often obtained in high productive soil rich in micronutrients and all required elements, it is always better to analyze the soil in the beginning. So that we can make decisions regarding adding of suitable fertilizers as well as for deciding which medicinal plants can be grown well in such type of soil.

Exploring the area here, we found the minute details of the soil like its texture, nutrient contents, etc. Since the cultivation of *Shweta musli* does not demand additional requirements besides alkaline pH of the soil and bund formation while sowing the fingers, this land can be ideal for cultivation. Adding Farmyard manure and Vermicompost can be enough with regular checks on the crops. The foremost important thing to keep in mind should be plowing deeply and leave the land for better aeration before sowing. Sowing should be ideally done between 15^{th} – 30^{th} June i.e before the onset of monsoon.

IV. CONCLUSION

As per *Ayurvedic* aspects, the soil at *Charak upvan* comes under the category of *Parthiva Bhumi when classified with respect* to *Mahabhoot* dominance, under *Kashaya Bhumi* as per *Shadrasa* category, under *Sharkara Bhumi* as per soil quality and texture, under *Shudra Kshetra* if we categorise the soil as per caste and under *Krishna Bhumi* as per color categorization. The mineral content of the soil is optimum for cultivation of medicinal plants like *Shweta musali*.

Criteria of Examination	Findings
1.Panchbhaoutik Constitution	Parthiva bhumi
2.Shadrasa	Kashaya bhumi
3.Soil Texture	Sharkara bhumi
4.Caste	Shudra bhumi
5.Colour(Varna)	Krishna bhumi

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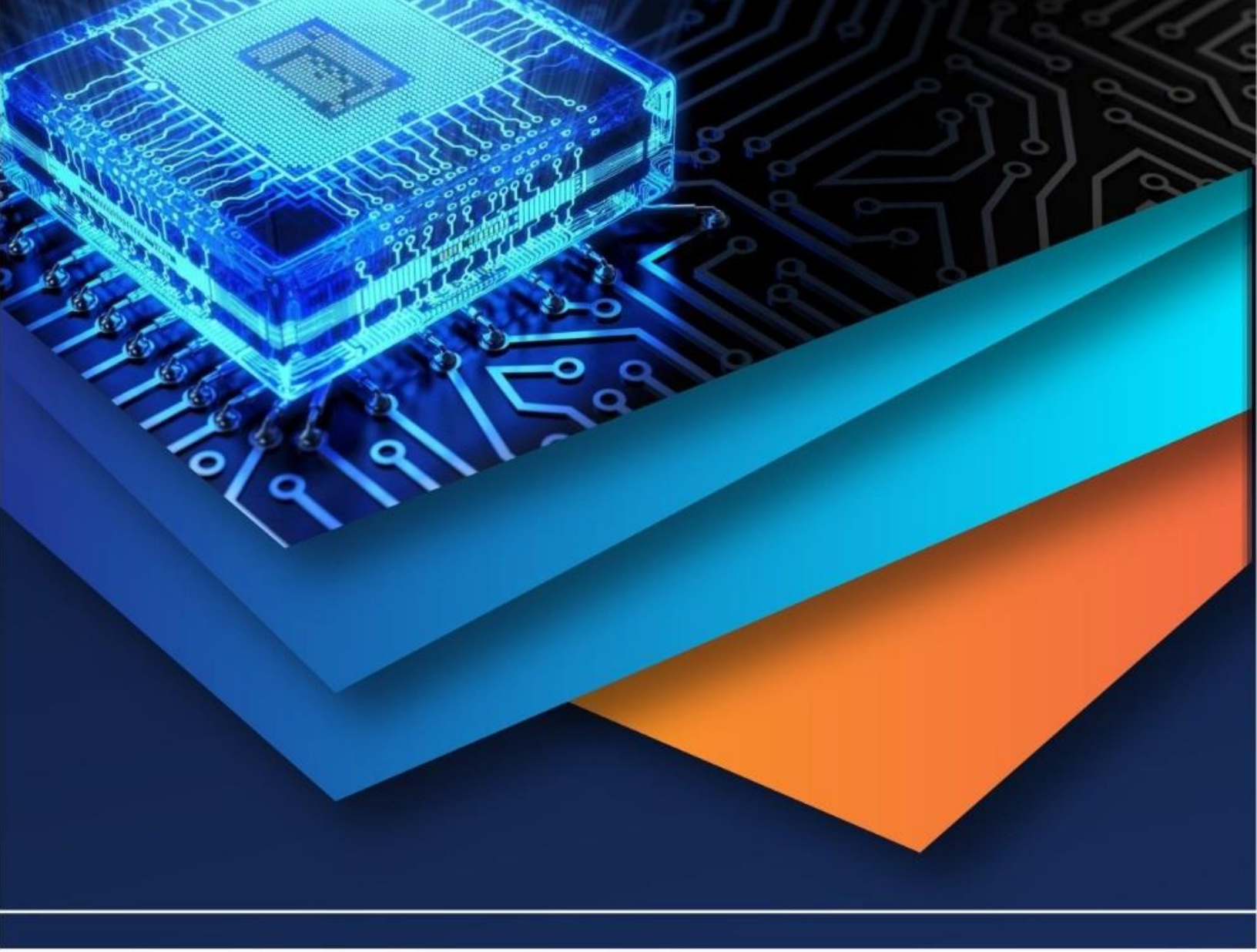

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