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Comparative Morphological, Anatomical Study and Stomatal Density in Different Urban Areas of Selected Plants in Coimbatore with Special Reference to Environmental Factors

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Abstract: ***In general stomatal density refers the number of stomata in a unit area. Light, moisture, temperature, humidity, carbon dioxide contents are some factors that may create significant changes in ecosystem. Comparative morphological, anatomical characters and study on stomatal density with respect to urban areas in Coimbatore evaluated the influence of environmental factors on stomatal density. The most significant variation occurred in Pongamia pinnata, (L.) Pierre.; and Thespesia populnea, Cav.;. Morphological and anatomical characters variations were least but not insignificant. Leaf sizes were reduced in different urban areas.Azadirachta indica, A. Juss.; have no feasible changes towards environmental factors revealed that Azadirachta indica, A. Juss.; can be tolerate extreme climatic changes so it have more adaptive values than other samples. Stomata reflect important changes in atmospheric composition as well as other kinds of environmental stresses. This diagnostic character raises the question of their value in phylogeny reconstruction.***
Keywords: Morphological, Anatomical characters, Leaf size, Stomatal density, Urban area, Environmental factors.

I. INTRODUCTION

Plant morphology examines ultra structure with aid of electron microscope through overlapping plant anatomy. Plant anatomy in general study of internal structure of plants but now often investigated at cellular level and often includes sectioning of tissues and observation through microscope. Plants are made up of shoot system and root system. Shoot system is above the ground level includes stem, leaves, flower and fruit. Root system includes root, underground organs and rhizomes (Jeffrey, 1917). Leaves are green, flat, thin, expanded lateral appendages of stem.Leaf cell have epidermis, mesophyll and vascular tissues. Epidermis is outer layer which secrete a waxy coating called cuticle for retain water. Stomata occupy in epidermis which allows plants to exchange gases and retain water. Middle layer mesophyll composed of palisade and spongy Mesophyll tissues. Leaf vascular tissues are found in spongy mesophyll which have of xylem and phloem for transport of water and nutrients (Jeffrey, 1917).

Number of stomata present in a unit area term as stomatal density. In general stomatal density sensitive to environmental conditions due to that decreases the amount which occurs in high concentrated. Pollution is one of the major problems that affect by our planet. Most of the cities are victims of air pollutions due to human uncontrolled population and pollution creating by them. Vehicles expel high amount of air pollutant to outside that contaminating air. When peoples respire it creates respiratory problems (Richard, 1987).In traffic area numbers of stomata will less due to rising carbon dioxide. Plants commonly respond to increase atmospheric CO_2 by adjusting their uptake of CO_2 and their water loss. When trees does not get much light there is more stomata so intake of CO_2 enough to complete photosynthesis. On other hand plant get lot of light has a low stomatal density because it is opens more during the course of the day and able to complete photosynthesis more often. Shade leaves are larger and thinner than normal sun leaves and often appear darker green.

II. MATERIALS AND METHODS

A. Study Area (Plate-1)

Tamil Nadu a south Indian state located extreme south of the sub-continent. Coimbatore is a major city in Tamil Nadu located on the banks of the Noyyal river and surrounded by the Western Ghats. Coimbatore has an average elevation of 2 meters covers the geographical area of 4175.00 Sq.km and has the population of 11, 87,604. The selected areas are Ramanathapuram, Sungam, Race course, sowripalayam Pirivu, Singanallur and Puliakulam. The six areas connected to each other for bus transport. Air pollution, lack of proper waste management infrastructure and degradation of water bodied are the major environmental issues in Coimbatore.

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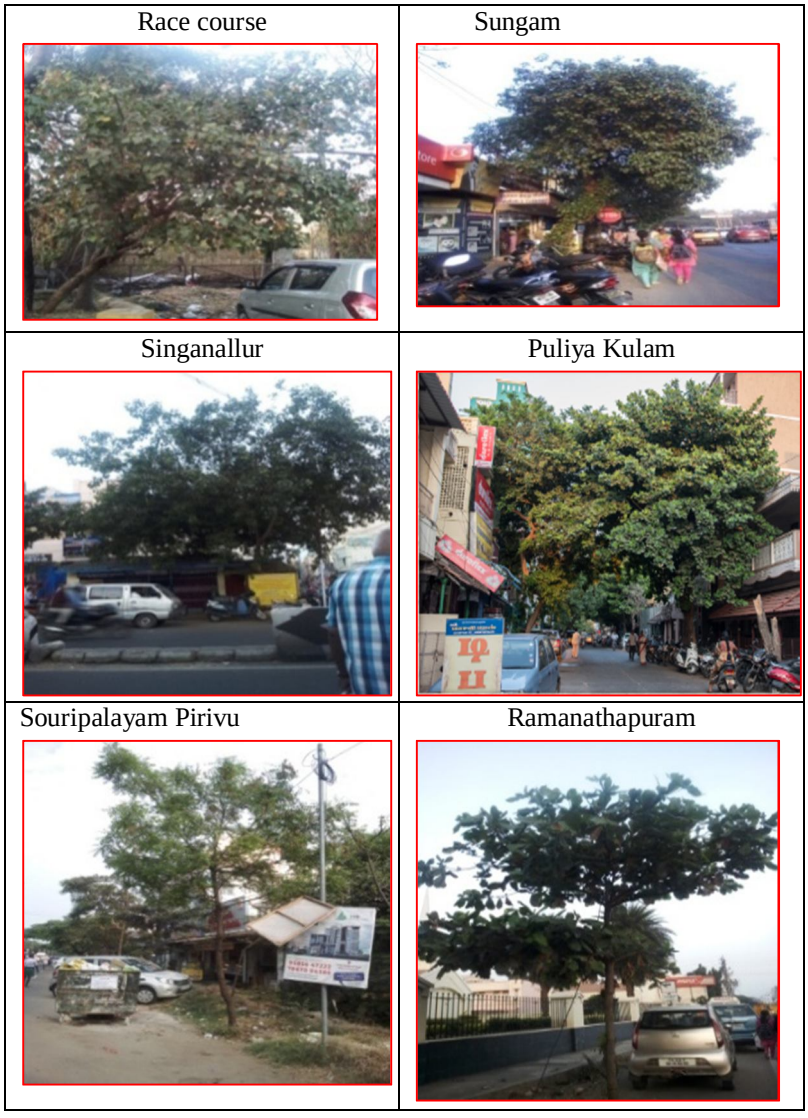
B. Selected Sample (Plate-2)

The selected leaf samples collected during in the month of October, 2018. These plants are identified by using Flora of the Presidency of Madras, J.S. Gamble, 2014. After that observed the morphological and anatomical characters.

1) *Morphological Observation (Jeffrey, 1917):* Observed the morphological characters like hair, trichomes, special glands, surface, length, structure or shape of leaves by using simple microscope.
2) *Anatomical Observation (Jeffrey, 1917):* After morphological observation determine anatomy of leaves by using staining.
3) *Measuring Of Stomatal Densities (Jeffrey, 1917):* Fresh leaves are collected and lower epidermis spread a thin layer of nail polish on the surface leave to dry. Place a strip of clear stick tape on nail polish peel. Place impression on slide. Using Razar blade removes excess part. Take stomata and Label the side with the plant name. Observed by using microscope having magnification 400X and 100X (Raynor, 1985).
4) *Statistical Data Analysis (Jeffrey, 1917):* For compare to epidermal cells count the number of stomata at least five areas. Take photographs through the eyepiece. The equation used to find the area was πr^2. Record the data and calculate stomatal density by using graph compare

Plate-2: Studied area of the selected samples Plate-3: Habit of selected samples



Sample-1: Terminalia catappa 	Sample-2: Tecoma stans 
Sample-3: Ficus religiosa 	Sample-4: Azadirachta indica 
Sample-5: Pongamia pinnata 	Sample-6: Thespesia populnea 

III. RESULTS AND DISCUSSION

Morphological structure of leaves and dust retaining capacity determined the significant difference among the samples in same places. Plants species exhibit significant reduction at all polluted areas intheir leaf length, width, area and petiole length during different seasons at urban areas compare to other non-urban areas. Some kinds of morphological and anatomical characters that occur on selected samples. For example special kind of sessile glands on Terminalia catappa, L.; and gall appearance on Pongamia pinnata, (L.) Pierre.;.Ficus religiosa, L.; and Thespesia populnea, Cav.; have coriaceous leaves with opposite leaf arrangement but Terminalia catappa, L.; and Tecoma stans,(L.) Juss. ex. Kunth.; have alternate leaf arrangement. The samples occurred in urban areas possess observable reduce in their leave size. In split of difference in surface properties cross sections of leaves did not reveals anatomical abnormalities.

Sample s collected from urban areas shows comparative variations in stomatal density. Among them samples from Ramanathapuram had least stomatal densities where had high traffic compare to other studied areas. In Race course most of the plants shows high stomatal density that means less influence of pollution. Pongamia pinnata,(L.) Pierre. ; shows high variation Stomatal density.Stomatal density shows differences in successive leaves of shoot as well as among the leaf of plants which growing under the various light intensities.

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Chart-1: Comparative study of stomatal density of selected samples in different urban area

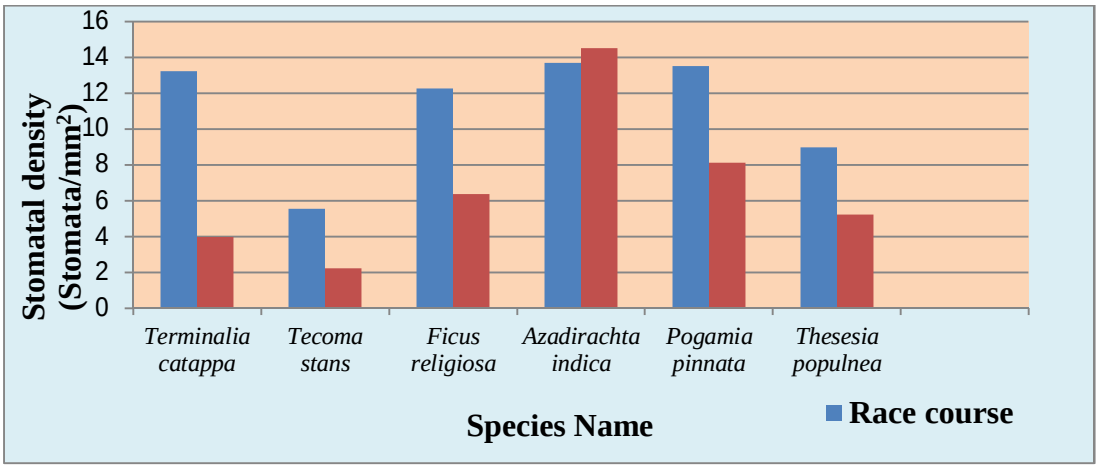
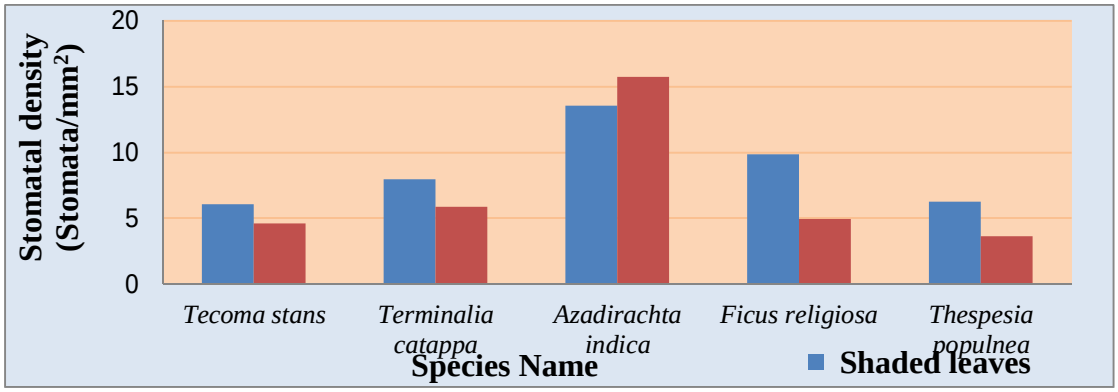
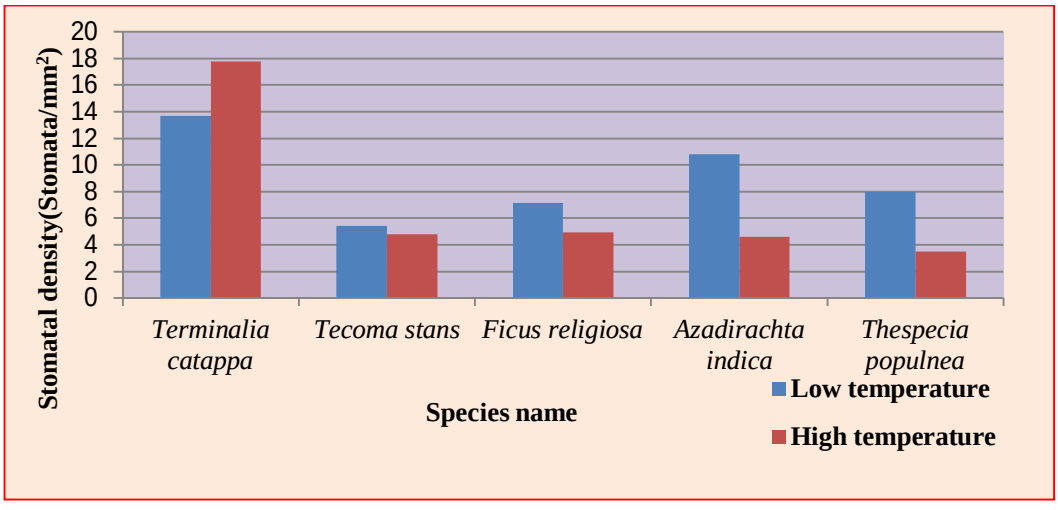


Chart- 2: Effect of Sun light on Stomatal density



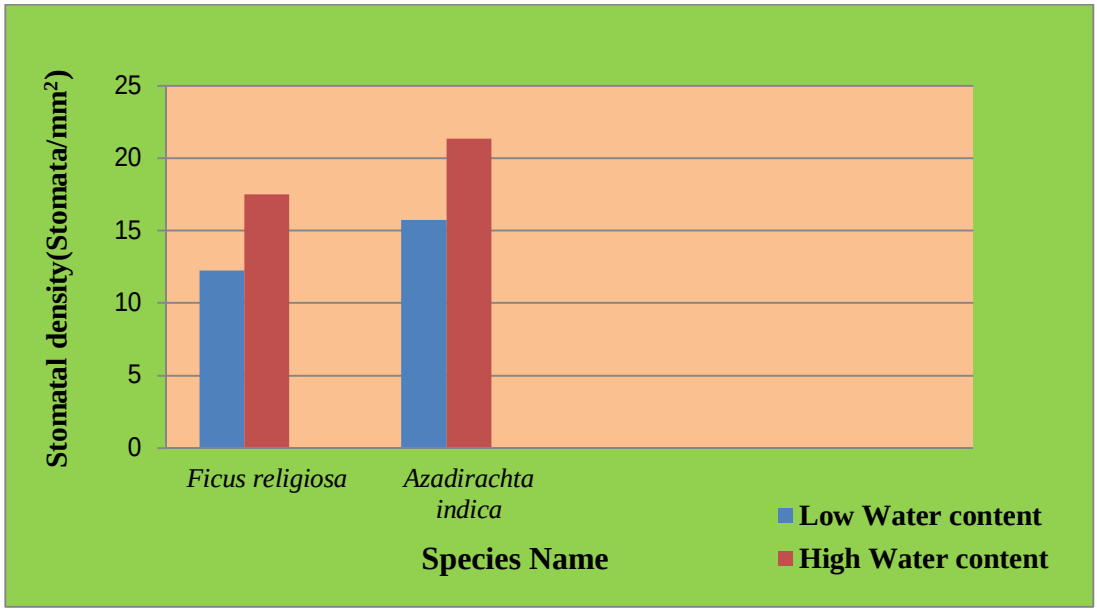
High intensity of light, temperature, moisture inversely proportional to stomatal density. In higher intensity of such factors shows less number of stomata in unit area. Due to extreme light number of stomata will less compare to shaded leaves. Shaded leaves were indicates more stomata density in which Thespesia populnea, Cav.; had least number. The leaves present under high light were fully expanded but numbers of stomata under high light were less. Among the selected Ficus religiosa, L.; had more variation when compare each of the values. Azadirachta indica, A. Juss.; have least or less variation happened because the light had no such effect on it.

Chart: 3- Influence of Temperature on stomatal density



In high temperature most of the species shows high stomatal density except Terminalia catappa, L.; (17.793). Thespesia populnea, Cav.; had lowest (3.053) stomatal density in high temperature regions (Table - 6). So when compared leaves under temperature the variation show adaptive nature of each of the sample. So here Terminalia catappa, L.; shows frequent variation compared to other samples. The response of stomata to gradual increase in temperature at increasing plant water stress was studied in a hot desert habitat in the field, but under controlled temperature and humid conditions.

Chart 4: Influence of water content on stomatal density



At low water stress the diffusion resistance for water vapour decreased in response to gradual increase in temperature. Transpiration increased but response was reversible. The opening of stomata with increasing temperature was apparently independent of stomatal density controlled but atmospheric humidity. At high temperature plants had water stress and stomatal response was reversed that is stomata closed when temperature gradually increased. The plant water potential at which the stomatal response to temperature was reversed differs among the species (Schulze et al., 1973).The data shows that Azadirachta indica, A. Juss.; had better result when compared to Ficus religiosa, L.; at high water Azadirachta indica, A. Juss.; had 21.337 stomatal densities. In low moisture Ficus religiosa, L.; had 12.260 stomatal density. So Azadirachta indica, A. Juss.; shows better result compared to Ficus religiosa, L.;. When high amount of water occur the plants shows high amount of stomatal density. So it reveals that water and stomatal density have a correlation to each other. There were observable changes in plants collected from low water. Thespesia populnea, Cav.; and Pongamia pinnata, (L.) shows grater results towards each of the climatic factors.

IV. CONCLUSION

The results shows that the plants which are occur near to the polluted area or which have affected by pollution gradually change their morphological appearance like leaf size, shape, structure. Stomatal pore size will be reduced due to the extreme effect of pollutants.

Pongamia pinnata (L.)Pierre.; shows greater response towards the environment so which is a good indicator of climatic changes. The changes in leaf size, stomata per unit area reduced due to it. This cleared by compare them by same plants from less traffic area. The plant under high light had less number of stomata compare to shade plant leaves. The plants under high temperature have more stomata in plant Terminalia catappa, L.; but others had opposite character.Water content also directly related to stomatal density the plants have higher stomatal content when compare plants from low water status. In the whole data plant Azadirachta indica, A. Juss .; had less variation when compared to others. So it can adapt to any conditions as such. Other plants were try to cope with extreme conditions by changing numbers of stomata, reduce size of leaf etc. So it can used to prevent atmospheric pollution. Thespesia populnea, Cav.; shows better result than others. Which have enormous changes due to environmental conditions. So these studies reveal that plants also have changes so when should start to take necessary action for future generation if not if will enter to a great loss.

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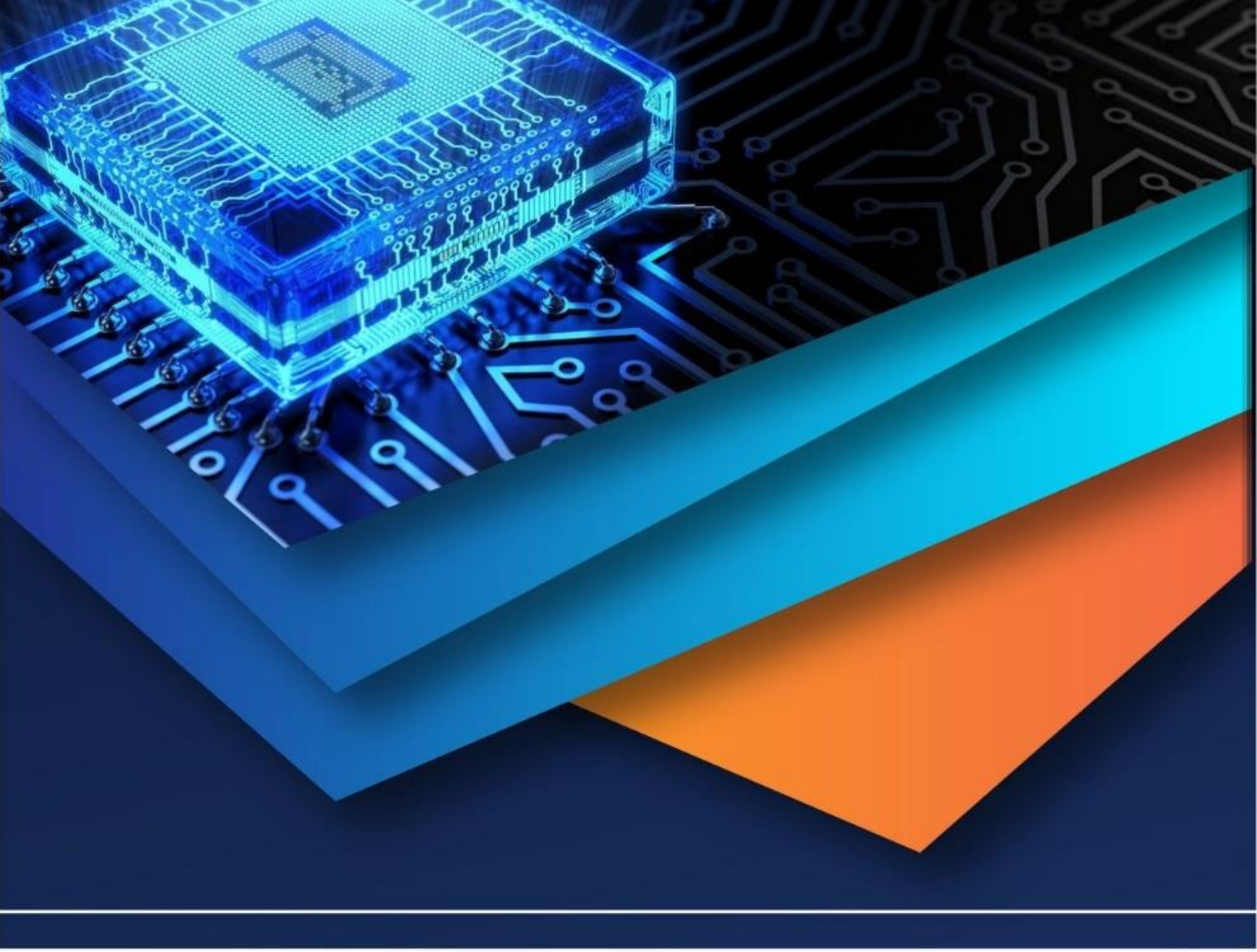

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