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Seasonal Variation and Habitat-wise Distribution of Orthopteran Fauna within the Campus of Shri Chhatrapati Shivaji Mahavidyalaya, Shrigonda, Maharashtra

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Abstract: ***The present study examined seasonal and habitat-wise variation in orthopteran fauna within the campus of Shri Chhatrapati Shivaji Mahavidyalaya, Shrigonda, Maharashtra. Observations were compiled from four habitats—the Agricultural Field, Grassland, Pond Area and Botanical Garden—during summer 2025, monsoon 2025 and winter 2025–26. A total of 162 individuals representing seven provisionally identified taxa were recorded. Monsoon supported the highest abundance with 87 individuals (53.70%), followed by summer with 47 (29.01%) and winter with 28 (17.28%). Grassland recorded the highest habitat-wise abundance with 57 individuals (35.19%), followed by the Pond Area with 46 (28.40%), Agricultural Field with 42 (25.93%) and Botanical Garden with 17 (10.49%). The Phaneroptera gracilis morphotype was dominant, contributing 34 individuals (20.99%), followed by Euconocephalus pallidus with 25 (15.43%) and Cyrtacanthacris tatarica with 24 (14.81%). Five katydid taxa contributed 120 individuals, while two short-horned grasshopper taxa contributed 42 individuals. Grassland exhibited the highest habitat-wise Shannon and Simpson diversity, whereas winter showed the highest seasonal evenness despite its lower abundance. The greater abundance recorded during the monsoon was probably associated with increased moisture, vegetation growth and food availability. As the observations consisted of pooled encounter counts without standardised replication, the results are presented as preliminary baseline information rather than population-density estimates. Future surveys should employ equal sampling effort, replicated transects, sweep-net and acoustic sampling, environmental measurements and taxonomically verified voucher specimens.***

Keywords: Orthoptera, grasshoppers, katydids, seasonal abundance, habitat distribution, campus biodiversity, Shrigonda

I. INTRODUCTION

Orthoptera is a diverse and ecologically important insect order comprising grasshoppers, locusts, katydids and crickets. Its members are generally classified into two major suborders: Caelifera, which includes short-horned grasshoppers and locusts, and Ensifera, which includes katydids and crickets. Orthopterans occupy grasslands, agricultural fields, forest margins, wetlands, gardens and several other natural and human-modified habitats (Uvarov, 1966, 1977; Chapman & Joern, 1990; Gangwere et al., 1997).

Most grasshoppers and katydids are closely associated with vegetation. Herbivorous species consume grasses, leaves, shoots, flowers and seeds, while several katydids are omnivorous and may also consume small invertebrates. Orthopterans influence plant biomass, nutrient movement and food-web interactions and constitute an important prey resource for spiders, insects, amphibians, reptiles, birds and small mammals (Joern, 1979; Belovsky & Slade, 1993; Capinera et al., 2004).

Although some grasshopper species may become agricultural pests when their populations increase, most orthopterans occur as natural components of terrestrial ecosystems. Their abundance and community composition respond to vegetation structure, moisture, temperature, grazing, cultivation and habitat disturbance. These characteristics have encouraged their use in ecological assessment and biodiversity monitoring (Andersen, 1999; Andersen et al., 2001; Samways & Lockwood, 1998).

Vegetation height, plant density, grass cover, exposed soil, and the availability of suitable food plants strongly influence orthopteran distribution. Grasslands generally provide continuous herbaceous vegetation and varied feeding, sheltering and calling sites. Agricultural fields contain crop plants, weeds and open soil, whereas pond margins provide comparatively moist vegetation. Managed botanical gardens may support diverse plant communities but also experience frequent maintenance and human disturbance (Joern, 1982; Gardiner et al., 2002; Kruess & Tscharntke, 2002).

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Seasonal changes affect orthopteran development, activity and detectability. Rainfall and humidity influence plant productivity, egg development, nymphal emergence and the availability of shelter and food. Monsoon vegetation may provide favourable conditions for many grasshoppers and katydids, while dry summers and cooler winters may reduce their activity or alter habitat use. Responses may differ among taxa because of variation in life cycles, feeding preferences, and microhabitat requirements (Joern & Pruess, 1986; Belovsky & Slade, 1995; Jonas & Joern, 2007).

Orthopteran surveys commonly employ visual searches, sweep-net sampling, quadrat counts, transects and acoustic observations. Survey results can be influenced by vegetation height, sampling time, observer technique and weather conditions. Standardised effort and independent replication are therefore necessary for reliable comparisons among habitats and seasons (O'Neill et al., 2002; Gardiner et al., 2005; Southwood & Henderson, 2000; Sutherland, 2006).

India supports substantial orthopteran diversity, but many institutional campuses and semi-urban habitats remain inadequately studied. Species-level identification can also be difficult because externally similar taxa may require examination of adult reproductive structures, detailed morphometry or acoustic characters. This is particularly important for species complexes within genera such as *Ducetia* and *Mecopoda* (Ingrisch & Shishodia, 2000; Shishodia et al., 2010; Heller et al., 2021; Tiwari & Diwakar, 2023).

The campus of Shri Chhatrapati Shivaji Mahavidyalaya, Shrigonda, contains an Agricultural Field, Grassland, Pond Area and Botanical Garden. These habitats occur within the same institutional landscape but differ in vegetation structure, soil exposure, moisture and management. The present investigation was undertaken to document orthopteran abundance across these four habitats during summer, monsoon and winter and to provide baseline information for future campus biodiversity monitoring.

A. *Objectives*

1) To document the orthopteran taxa observed within the college campus.
2) To determine seasonal abundance during summer, monsoon and winter.
3) To compare abundance among the Agricultural Field, Grassland, Pond Area and Botanical Garden.
4) To identify dominant and comparatively less abundant taxa.
5) To calculate taxon richness, Shannon diversity, Simpson diversity and Pielou's evenness.
6) To generate baseline information for future ecological monitoring and taxonomic investigation.

II. MATERIALS AND METHODS

A. *Study Area*



Fig. Main entrance of Shri Chhatrapati Shivaji Mahavidyalaya, Shrigonda, Maharashtra—the study area.

The investigation was conducted within the campus of Shri Chhatrapati Shivaji Mahavidyalaya, Shrigonda, District Ahilyanagar, Maharashtra, India. Four habitat categories were represented in the field records.

1) Agricultural Field: The Agricultural Field contained cultivated plants, seasonal weeds, grasses and patches of exposed soil. These features provided feeding, resting and movement surfaces for both foliage-associated and ground-active orthopterans.
2) Grassland: The Grassland was dominated by grasses, herbs and seasonal vegetation. Variation in plant height and density created a range of feeding, sheltering and calling sites.
3) Pond Area: The Pond Area included moist soil and marginal vegetation surrounding the campus water body. Higher moisture and relatively dense plant growth distinguished it from the drier habitats.
4) Botanical Garden: The Botanical Garden contained ornamental plants, grasses, herbs, shrubs and other managed vegetation. These plants provided foliage and resting surfaces, although regular maintenance and human movement may have influenced habitat continuity.

B. *Study Period*

The observations covered one annual cycle divided into three seasons.

Season	Observation period
Summer 2025	February–May 2025
Monsoon 2025	June–September 2025
Winter 2025–26	October 2025–January 2026

C. *Field Records and Data Compilation*

Orthopteran individuals encountered during field observations were recorded separately for each habitat and season. The observations were entered in seasonal field sheets and later compiled into a taxon × habitat × season abundance matrix.

Blank cells in the original field sheets were interpreted as zero observations. The records did not specify the survey duration, the area searched, the number of observers, or independent replicate counts. The numerical values were therefore treated as pooled encounter abundance and not as estimates of population density.

D. *Taxonomic Identification*

The recorded orthopteran taxa were identified using standard field guides, available taxonomic literature, and diagnostic external morphological characters such as body size, colour patterns, antennae, wing structure, and hind-leg morphology. The nomenclature used in the manuscript follows the names recorded during field identification.

Table 1. Taxonomic Identification of Grasshopper Species.

Sr. No.	Scientific Name	Identification status
1	*Ducetia japonica*	Identified using field guides
2	*Cyrtacanthacris tatarica*	Identified using field guides
3	*Conocephalus gracillimus*	Identified using field guides
4	*Phaneroptera gracilis*	Identified using field guides
5	*Anacridium aegyptium*	Identified using field guides
6	*Mecopoda elongata*	Identified using field guides
7	*Euconocephalus pallidus*	Identified using field guides

The identifications were based on observable external characteristics and comparison with standard field guides. No molecular analysis or examination of genital structures was undertaken during the present study.

E. *Data Analysis*

The compiled data were analysed for seasonal, habitat-wise and taxon-wise abundance, relative abundance, taxon richness, Shannon–Wiener diversity, Simpson diversity and Pielou's evenness.

Relative abundance was calculated as:

$$\text{Relative abundance (\%)} = (n_i/N) \times 100$$

where n_i is the number of individuals belonging to a particular taxon, and N is the total number of individuals.

The Shannon–Wiener diversity index was calculated as:

$$H' = -\Sigma\, p_i \ln p_i$$

Simpson diversity was calculated as:

$$1 - D = 1 - \Sigma\, p_i^2$$

Pielou's evenness was calculated as:

$$J' = H'/\ln S$$

where p_i is the proportional abundance of the ith taxon, and S is the observed taxon richness (Shannon & Weaver, 1949; Simpson, 1949; Pielou, 1966; Magurran, 2004).

Inferential statistical tests were not applied because independent replicate-level observations and standardised sampling-effort data were unavailable. Applying significance tests to pooled observations would risk pseudoreplication (Hurlbert, 1984).

III. RESULTS

A. Overall Composition

A total of 162 individuals representing seven provisionally identified orthopteran taxa were recorded during the investigation.

Five taxa represented katydids or long-horned orthopterans and together contributed 120 individuals, accounting for 74.07% of the observations. Two taxa represented short-horned grasshoppers and contributed 42 individuals, accounting for 25.93%.

B. Seasonal Abundance

Monsoon recorded the highest abundance with 87 individuals, representing 53.70% of the total. Summer recorded 47 individuals (29.01%), while winter recorded 28 individuals (17.28%).

Table 2. Seasonal abundance and relative abundance of the recorded orthopteran taxa

Recorded taxon	Summer	Monsoon	Winter	Total	Relative abundance (%)
Ducetia cf. japonica	6	12	5	23	14.20
Cyrtacanthacris cf. tatarica	11	10	3	24	14.81
Conocephalus sp.	3	12	5	20	12.35
Phaneroptera cf. gracilis	12	18	4	34	20.99
Anacridium sp.	6	9	3	18	11.11
Mecopoda sp. (elongata group)	3	11	4	18	11.11
Euconocephalus cf. pallidus	6	15	4	25	15.43
Total	47	87	28	162	100.00
Percentage	29.01	53.70	17.28	100.00	

All seven taxa were represented during each season. Monsoon supported more than half of the total individuals, whereas winter showed the lowest abundance.

C. Habitat-wise Abundance

Grassland supported the highest abundance, with 57 individuals, followed by the Pond Area with 46, the Agricultural Field with 42, and the Botanical Garden with 17 individuals.

Table 3. Habitat-wise distribution of the recorded orthopteran taxa

Recorded taxon	Agricultural Field	Grassland	Pond Area	Botanical Garden	Total
Ducetia cf. japonica	5	6	10	2	23
Cyrtacanthacris cf. tatarica	8	9	5	2	24
Conocephalus sp.	3	6	8	3	20
Phaneroptera cf. gracilis	9	12	9	4	34

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Anacridium sp.	6	6	4	2	18
Mecopoda sp. (elongata group)	4	8	4	2	18
Euconocephalus cf. pallidus	7	10	6	2	25
Total	42	57	46	17	162
Percentage	25.93	35.19	28.40	10.49	100.00

Grassland recorded the highest abundance of *Cyrtacanthacris cf. tatarica*, *Phaneroptera cf. gracilis*, *Mecopoda* sp. and *Euconocephalus cf. pallidus*. The Pond Area supported the highest abundance of *Ducetia cf. japonica* and *Conocephalus* sp.

D. Dominant Taxa

The *Phaneroptera cf. gracilis* morphotype was the most abundant taxon, with 34 individuals representing 20.99% of the total abundance. It was followed by *Euconocephalus cf. pallidus* with 25 individuals (15.43%), *Cyrtacanthacris cf. tatarica* with 24 (14.81%), *Ducetia cf. japonica* with 23 (14.20%) and *Conocephalus* sp. with 20 individuals (12.35%). *Anacridium* sp. and *Mecopoda* sp. were the least abundant taxa, with 18 individuals each and a relative abundance of 11.11%.

E. Season-wise Diversity

Table 4. Season-wise diversity indices

Season	Abundance	Taxon richness	Shannon index H′	Simpson diversity 1−D	Pielou's evenness J′
Summer	47	7	1.828	0.823	0.939
Monsoon	87	7	1.920	0.850	0.987
Winter	28	7	1.928	0.852	0.991

Winter recorded the highest Shannon diversity and evenness despite supporting the lowest abundance. This pattern occurred because winter individuals were distributed comparatively evenly among all seven taxa. Summer showed the lowest diversity and evenness.

F. Habitat-wise Diversity

Table 5. Habitat-wise diversity indices

Habitat	Abundance	Taxon richness	Shannon index H′	Simpson diversity 1−D	Pielou's evenness J′
Agricultural Field	42	7	1.888	0.841	0.970
Grassland	57	7	1.911	0.847	0.982
Pond Area	46	7	1.887	0.840	0.970
Botanical Garden	17	7	1.905	0.844	0.979

Grassland showed the highest abundance, Shannon diversity, Simpson diversity and evenness. Although the Botanical Garden contained the fewest individuals, all seven taxa occurred there, and their distribution was comparatively even.

IV. DISCUSSION

The orthopteran assemblage showed noticeable variation in descriptive traits across seasons and habitats. Monsoon accounted for 53.70% of all recorded individuals. Increased rainfall and moisture during this period probably promoted the development of grasses, herbs and weeds, thereby increasing the availability of food, shelter and calling surfaces. Seasonal responses of grasshopper communities are often linked with weather, vegetation productivity and the timing of nymphal and adult development (Joern & Pruess, 1986; Belovsky & Slade, 1995; Jonas & Joern, 2007).

Although the monsoon supported the greatest abundance, winter showed slightly higher Shannon diversity and evenness. This did not reflect greater taxon richness because all seasons contained the same seven taxa. Instead, winter individuals were more uniformly distributed among taxa, whereas monsoon counts contained comparatively large numbers of *Phaneroptera cf. gracilis* and *Euconocephalus cf. pallidus*. Diversity values obtained from pooled counts should nevertheless be interpreted cautiously because sampling effort and detectability were not standardised.

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Grassland was the most productive habitat, contributing 35.19% of the total abundance. Continuous herbaceous vegetation and variation in plant height probably supplied suitable feeding, resting, concealment and calling sites. Grasshopper and katydid assemblages are often strongly influenced by sward height, plant composition, soil exposure and the spatial arrangement of vegetation (Joern, 1982; Gardiner et al., 2002; Kruess & Tscharntke, 2002).

The Pond Area ranked second in abundance and contained the highest numbers of *Ducetia cf. japonica* and *Conocephalus* sp. Moist soil and dense marginal vegetation may have created favourable conditions for foliage-dwelling katydids. However, humidity, vegetation density and plant composition were not measured, and the apparent association should therefore be viewed as a hypothesis for future investigation rather than a demonstrated habitat preference.

The Agricultural Field supported 25.93% of the total abundance. Crop plants, weeds and exposed ground may have provided food and resting surfaces, while cultivation, removal of weeds and other management activities may have periodically altered habitat structure. Agricultural and grazing practices can influence grasshopper abundance by modifying food availability, vegetation height, microclimate and oviposition sites (O'Neill et al., 2003).

The Botanical Garden recorded the lowest abundance, with 17 individuals. Regular maintenance, removal of grasses and frequent human movement may have reduced the continuity of herbaceous microhabitats. Nevertheless, all seven taxa were present and the assemblage showed high evenness. The site therefore contributed to overall campus diversity despite supporting relatively few individuals.

The *Phaneroptera cf. gracilis* morphotype was the dominant taxon and occurred in every season and habitat. Katydids formed nearly three-fourths of the recorded assemblage, indicating the importance of foliage-associated Ensifera in the campus landscape. The occurrence of several provisional katydid taxa also highlights the need for acoustic and morphological verification. Katydid species that appear externally similar can differ in male calling songs, stridulatory structures and genital morphology (Ingrisch and Shishodia, 2000; Heller et al., 2021).

The four habitats made complementary contributions to the observed assemblage. Grassland supported the greatest abundance and diversity, the Pond Area supported comparatively high numbers of foliage-associated taxa, the Agricultural Field contained both grasshopper and katydid morphotypes, and the Botanical Garden retained all recorded taxa at lower abundance. Maintaining grass cover, pond-margin vegetation, crop-associated non-invasive weeds and structurally varied garden vegetation may help conserve local orthopteran fauna.

The investigation has several limitations. Counts were pooled by season, while survey duration, area searched, observer effort and independent replication were not documented. The findings consequently represent encounter abundance rather than population density or statistically demonstrated habitat preference. Survey technique can strongly affect estimates of orthopteran abundance and community composition, particularly where vegetation structure differs among sites (O'Neill et al., 2002; Gardiner et al., 2005).

Taxonomic conclusions are also preliminary. Adult voucher specimens, measurements, reproductive structures and calling songs were unavailable. The reported taxa should therefore be interpreted as provisionally identified morphotypes. This conservative treatment is especially important for *Ducetia* and *Mecopoda*, which include complexes of closely related forms (Heller et al., 2021; Tiwari & Diwakar, 2023).

V. CONCLUSION

The present study documented 162 orthopteran individuals representing seven provisionally identified taxa from four habitats within the campus of Shri Chhatrapati Shivaji Mahavidyalaya, Shrigonda. Monsoon supported the highest seasonal abundance, while winter recorded the lowest. Grassland was the most abundant and diverse habitat, followed by the Pond Area, the Agricultural Field, and the Botanical Garden.

The *Phaneroptera cf. gracilis* morphotype was dominant, followed by *Euconocephalus cf. pallidus* and *Cyrtacanthacris cf. tatarica*. Katydids represented the major component of the recorded assemblage. The observed patterns suggest that seasonal moisture, vegetation growth, and habitat structure may influence orthopteran occurrence on campus.

The study provides preliminary baseline information rather than definitive estimates of density or habitat preference. Future investigations should use monthly sampling, equal survey effort, replicate transects, sweep-net and acoustic surveys, vegetation measurements, climatic records and taxonomically verified voucher specimens.

VI. ACKNOWLEDGEMENTS

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Author Contributions

Conceptualisation: Rhushikesh S Suryawanshi

Field observations: Akanksha S Bade

Data compilation: Akanksha S Bade

Data analysis: Rhushikesh S Suryawanshi

Taxonomic assessment: Akanksha S Bade

Manuscript preparation and revision: Rhushikesh S Suryawanshi

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The study received no external funding.

Conflict of Interest

The authors declare that they have no conflicts of interest.

Ethical Statement

The investigation was based on field observations and numerical encounter records. No experimental manipulation of animals was undertaken.

Data Availability

The numerical data used in the study are presented in the manuscript. The original field sheets may be made available by the corresponding author upon reasonable request.

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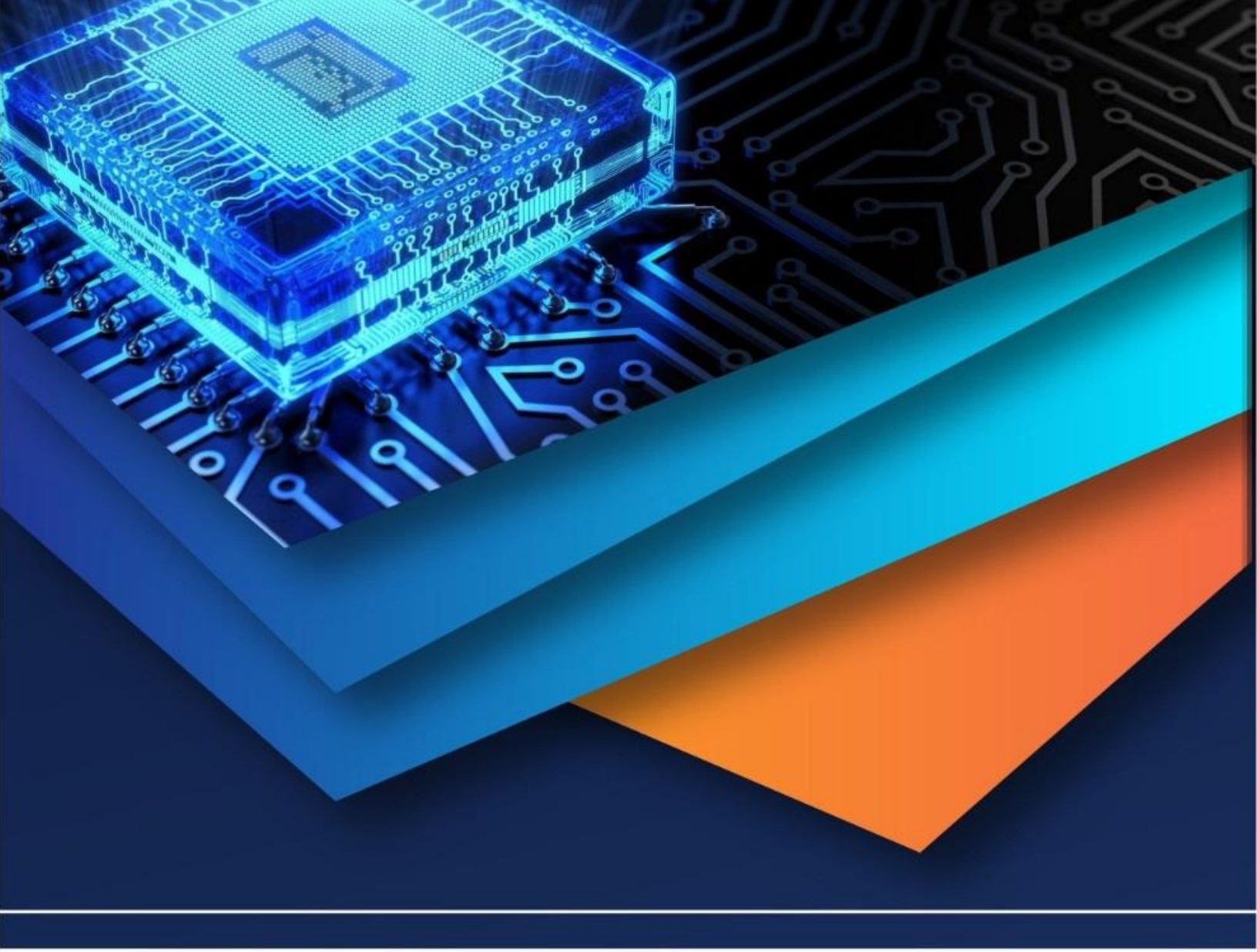
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