iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** V **Month of publication:** May 2022

DOI: https://doi.org/10.22214/ijraset.2022.42286

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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 10 Issue V May 2022- Available at www.ijraset.com

Review on Design of Rooftop Rainwater Harvesting in Gandhi Institute for Technology (GIFT), BBSR

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Abstract: ***Water is the main asset on the earth. Which requires water for different exercises in our everyday life at the rate at which India's general population is growing, it is said that India will undoubtedly replace China from its fundamental place as the most thickly populated country in the world. This will provoke a high pace of use of most huge trademark resource "Water" achieving development of loads on the permitted freshwater resources and supply of it is diminishing at a quickly protected on this planet. Remembering the ultimate objective to proportion and deal with our step by step interest in water essential, we need to think of elective adroit and respectably easier mechanical methodologies of preserving water.***
The specialized part of this venture is water harvesting gathered from GIFT main building rooftop. Above all else, a little piece of the rooftop is taken where a steep slant is available where water overflows streams and the point of this venture is to gather and store that water and use the water by giving a legitimate method for filtration. The task begins by gathering some significant investigations on water Harvesting and concentrating on them. A legitimate arranging work led to GIFT for an appropriate picture of what is going on at GIFT College and to quantify the elements of the rooftop catchment area. Then other required information is gathered for example hydrological precipitation information and temperature. The volume of water will ascertain thereafter. Water collecting potential for the school will ascertain, and an appropriate plan will be considered. The vital variable of this undertaking is the channel unit which will be planned productive and prudent and possible to carry out in the school. In conclusion, this venture is taken on for preserving the main normal source on the earth. It is a drive to safeguard the water source. "Save Water, automatically Water will save us".
Keywords: Rooftop harvesting, channel configuration, rooftop catchment area.

I. INTRODUCTION

A. Present water situation in Odisha

Odisha has been going through water shortage, dry season, floods, groundwater consumption, and considerably more. In Odisha, the groundwater extraction has expanded to 42 percent, from 30% in four years — somewhere in the range of 2013 and 2017.
There is a gigantic expansion in yearly groundwater extraction. Yet, there is a decrease in yearly groundwater recharge and significant exhaustion in the yearly extractable groundwater assets.
Since the summer season showed up before the expected time this year and is supposed to be hotter than expected, we should be more ready than in earlier years to guarantee legitimate water supply in the provincial and metropolitan regions: CM Naveen Patnaik
Water collecting is a go-to answer for the arising water emergency. Like Odisha, it is about time for us to do whatever it takes to recharge the groundwater consequently empowering the planet to give the greatest assets to our approaching ages.
As per the Central Ground Water Board (CGWB), Odisha's groundwater volume was surveyed at 16.69 billion cubic meters in 2009. This has dropped to 15.57 billion cubic meters in 2017, prompting a deficiency of 1.12 billion cubic meters (6.71 percent) of groundwater. The CGWB has demonstrated that the groundwater of 24 out of 30 locales in Odisha is draining. The groundwater aquifers in numerous areas of Odisha have proactively gone dry. In 2019, out of 30 regions in Odisha, 29 had gotten lacking precipitation, while just the Koraput area recorded one percent overflow precipitation. In nine areas, downpour deficiency has been estimated to be more than 40%. Balasore was the most awful hit, with 54% shortfall precipitation. Upwards of 26 regions had a deficiency of over 19%. This present circumstance is deteriorating.

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Around 1,093 million liters of drinking water are provided to metropolitan regions in the state against the day-to-day interest of 1,088 million liters. This is prompting monstrous tension on the state's water assets.

The groundwater level in the more prominent Bhubaneswar region (Bhubaneswar city and edges/peripheries) has contracted by around 10 meters and more beginning around 2006 and water utilization has multiplied over the most recent 10 years. This has been because of the enormous scope of extraction of groundwater to take care of the day-to-day interests of Bhubaneswar.

As per The Hindu (TH), over one month into southwest rainstorm season, a shortage of water, both for drinking and water system purposes, keeps on tormenting individuals of Odisha.

Rooftop rainwater harvesting gathering/water procuring is the system through which downpour water is gotten from the roof catchments and water is taken care of in tanks, wells, and stores. Gathered downpour water can be taken care of in a sub-surface groundwater storehouse by getting produced stimulate procedures to meet the nuclear family needs through limit in tanks. Groundwater resources get typically resuscitated through penetration. In any case, due to isolating improvement and quick urbanization, revealed surface for soil has been diminished certainly with a resultant diminishment in pervasion of water, in this way depleting groundwater resource. Water harvesting is the way toward growing the typical filtration of water into the underground improvement by a few fake techniques. The awareness, get-together and limit of water to consider solicitations of water for drinking, and water framework is named as Rainwater Harvesting.

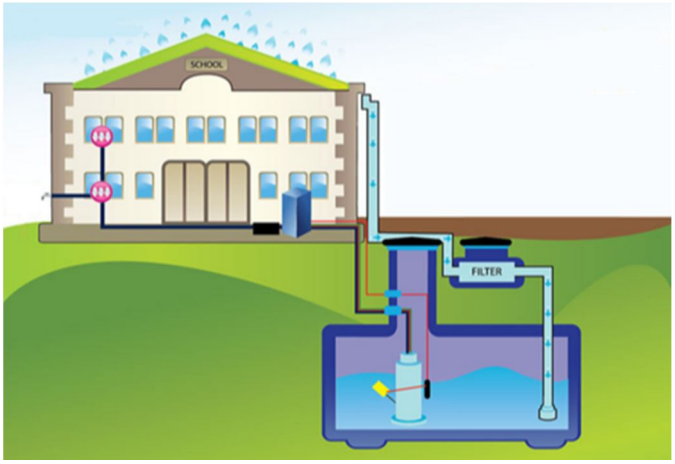


Fig. 1 Rooftop Rainwater Harvesting

B. Components of Rooftop Rainwater Harvesting

Components of rooftop rainwater harvesting as shown in below



Fig. 2 Components of rooftop rainwater harvesting

1) Roof catchment
2) Down pipe
3) First flushing pipe
4) Filter Unit
5) Storage Tank

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue V May 2022- Available at www.ijraset.com

C. Benefits of Rainwater Harvesting System

In the wake of harvesting the rooftop water following advantages will acquire:

1) Rainwater is a moderately unblemished and free wellspring of water.
2) Rainwater is improved for scene plants and gardens since it isn't chlorinated.
3) It can enhance different wellsprings of water supply, for example, groundwater or civil water associations.
4) It lowers the water supply cost.
5) It can give an extraordinary drop-down wellspring of water for emergencies.
6) It is socially satisfactory and normally able.
7) It usages essential advancements that are efficient and easy to keep up with.
8) Reduced flood streams and dirt mishaps.
9) It is free; the main expense is for assortment and use.
10) It decreases the contamination of surface water with buildup, manures, and pesticides from water run-off resulting in cleaner lakes, streams, oceans, and various beneficiaries of storm water.
11) It is used as a piece of those locales that go up against lacking water resources.
12) It can be used to simulate groundwater.

D. Need for Rainwater Harvesting

In today's condition, the need for downpour water action is needed at home. Its need is as given underneath:

1) As water is winding up interesting, it is just the need of the day to achieve autonomy to fulfill the water needs.
2) As metropolitan water supply framework is under a gigantic load for giving water to reliably extending people.
3) Groundwater is getting exhausted and polluted.
4) Soil deterioration coming about due to the unrestrained overflow.
5) Health dangers as a result of the use of defiled water.

II. LITERATURE REVIEW

Writing audit connected with the rainwater harvesting was done. The Subjective exploration techniques were used to accumulate data on the usage, errand, and backing of water gathering frameworks. Starting, an examination of helper data, for instance, various reports, papers, rules, and methodologies were finished to overview experiences from water harvesting adventures that have quite recently been realized by various associations wherever all through the world. The following papers are taken from sites like the Department of water assets (DoWR), International Soil and water Conservation Research, International Journal of Scientific and Engineering Research, Tata Institute of Social Sciences, Journal For Contemporary Research In Management, Universal Journal of Environmental Research and Technology, Central Ground Water Board, Journal Of Cleaner Production, Research Gate, Journal Of Environmental Management, Water Science And Engineering, African Journals Of Agricultural Research, Journal Of Hydrology. [6]

As per Krishnaveni et.al. (2016) "Hydrologic plan of water harvesting framework at Anna University, Chennai". This work is the legitimate framework by arranging potential downpour water procuring framework in Anna College an essential spot of the city where 1,000 peoples move in and out every day in the circumstance of the school water supply appears to be the chance of incidental disappearing extended water safeguarding will keep up an abundant water supply later on. In this manner processed the conceivable water to be harvested. Then, at that point, reliable precipitation information was determined. Then, at that point, the interest estimations are finished including net inflow and sump limit, number of sumps. Likewise, they deduce that this assessment gives important information to work with the progression of water procuring practice in Chennai and for other dried and semi-dry region of the world. [9]

As indicated by Nawale et.al. (2015) the work done on water collecting frameworks in Pune city: The excellent target of this work was appropriate upkeep in will bring powerful use of this framework. For states of water collecting framework, they decipher that it was clear that there was the presence of sources which would weaken the water and meanwhile First flush redirection technique which was of almost importance to water gathering was not being utilized. With the help of the water procuring framework, they unravel that it was certain that the water gathering framework is in extraordinary condition as the rooftop, channels, and drains are suitably kept up. For the Frequency of cleaning water gathering framework, they translate that cleaning should be achieved at least a couple of times a year. [3]

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As per Patel et.al. (2014) the work completed on Rooftop rainwater harvesting at Visnagar, SPSV Campus: Gujrat - A contextual analysis. Their concentration significantly centers on rooftop rainwater harvesting of the review region as Sankalchand Patel Sahakar Vidyadham (SPSV) Campus.

The superb goals of their work were to satisfy the shortage of the water grounds and afterward should be using it for homegrown and drinking water supply. In approach, they've decided on a few applications, for example, (1) what the caught water to be utilized for (2) what amount of water can be captured(3) the assortment Surface (4) Calculation of the volume of precipitation likewise (5) Rainfall information assortment (6) Determination of catchment region (7) Hydrological investigation (8) Computation of volume of overflow each year. It was at long last presumed that execution of a water collecting venture on the grounds of S.P.S.V. will be the best way to deal with a battle with the present situation of water shortage from all perspectives, whether it is according to a monetary perspective or from ideal usage of the land surface. [12]

As indicated by Pawar et.al. (2014) the work done on rooftop rainwater gathering of Renavi town in Sangli region of western Maharashtra: Article presents that the example of overcoming adversity of rooftop rainwater harvesting. The likely evaluation of the town uncovered that around 20 days, lakh liters of water gathered from roofs, will fulfill the interest of a populace of 1300 for no less than 78 days.

This assessment was according to the assembled country guidelines. An aggregate of Rs. 6, 04,000 was contributed as a commitment by Government organizations and townspeople for the Funding of the water gathering program in light of precipitation information is gathered. The coefficient of overflow for the area is figured. The houses with and without rooftop rainwater harvesting structures was been assessed and ultimately groundwater quality appraisal from the open well and bore wells was determined. This work presumed that the downpour water reaping measures helps in satisfying the homegrown water need to further develop the groundwater level by a couple of meters. Then again, in certain provinces of India, for example, Andhra Pradesh, Madhya Pradesh, Gujarat, and Rajasthan the degree of fluoride in groundwater was over the reasonable limit. [13]

As per Solanki et.al. (2015) the work completed on water gathering in KJCOEMR at KJEI grounds, Pune: In this exploration paper they have plotted a preparation of water collecting in K.J. Instructive foundation arranged in Tal-Haveli, Dist- Pune, Maharashtra. Creators determined the coefficient of spillover according to the areas like metropolitan regions, single-family homes, developed regions, and woodland. Then, at that point, the volume of overflow in K.J. grounds was been determined. A review was wanted to plan a permeation pit to gather downpour water and recharge groundwater aquifers to improve or keep up with the groundwater nature of very much situated in K.J. grounds gets heavy rains during storm season. Three underground tanks can be arranged would be gainful for the ideal reason according to plan. Lastly, it was presumed that carried out the water gathering venture to the K.J. working in the KJEI grounds to battle the present situation of water shortage from all angles, from monetary as well as ideal use of land Resources. [15]

III. METHODOLOGY

A. Objectives

Present work is having following goals:

1) To review the water gathering capability of that rooftop.
2) To moderate, safeguard and use rainwater.
3) To recognize reasonable planning for harvesting framework.
4) To utilize the most productive and compelling housetop water collecting framework on the college rooftop.
5) To raise the underground water table by recharging the gathered rooftop rainwater.
6) To review the plan of the water tank and channel unit.
7) To increase groundwater table and capture groundwater decline.
8) To beneficiate water quality in springs.

B. Study Area

The site is at Gandhi Institute for Technology, Paniora, Dist-Khordha. The site lies an latitude of Paniora, Khordha, India is 20.2236, and the longitude is 85.6722 Pandora, Khordha, India is situated at India country in the cities place category with the GPS co-ordinates of 20.22230° N and 85.67292°' E. It is arranged 20km away from the state water server farm. It has an area of 100m^2. Fig. No. 3 and 4 show maps of GIFT College.

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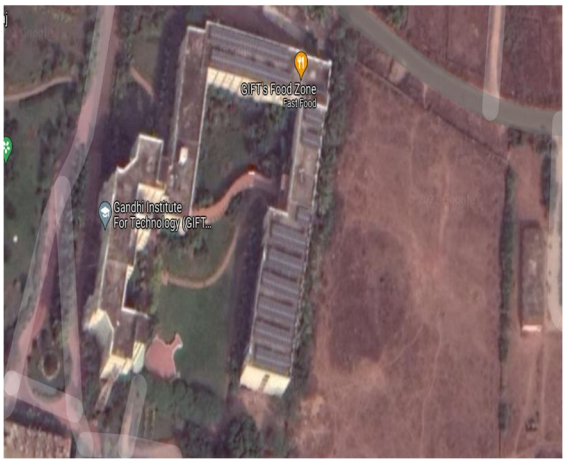


Fig. 3 Map of study area of GIFT College.



Fig. 4 Location map of study area of GIFT College.

C. Data Collection

The significant required information like yearly rainfall intensity, temperature, runoff, humidity, and so on. During the visit, we gathered the ground information which is study no. of the house, sort of design, aspects of the house, rooftop region and construction for harvesting, and so forth.

The nearest downpour measure station (rain gauge station), vadaj dam is situated close to the site to collect yearly precipitation information from earlier years which will assist us with planning an effective Rooftop rainwater harvesting system.

Table 1: Measurement of area of building

Sl No. .	BUILDING NAME	TYPE OF STRUCTURE	DIMENSIONS		STRUCTURE FOR HARVESTING	REMARK
			L	B		
1.	Academic building	SLOPPING ROOF	50m	50m	UNDERGR OUND TANK	N $19^0$09.29’ E $73^0$52.35’ 722M

The above Table shows estimations of buildings. The absolute catchment area will be computed in this progression and for that, we have collected the information on the catchment rooftops on which water is gathered.

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Volume 10 Issue V May 2022- Available at www.ijraset.com

D. Annual Rainfall Data

For working out yearly precipitation past long-term precipitation information was gathered. Precipitation from high intensity, brief span precipitation occasions might be lost to flood from capacity tanks or sprinkle out from the drains. Albeit these extreme precipitation occasions are viewed as a component of the combined yearly precipitation, the complete accessible volume of such an occasion is seldom caught. Another thought is that most precipitation happens occasionally; yearly precipitation isn't equitably conveyed all through the year of the year.

However, what we need is the typical yearly precipitation for a city or a topographical region. That is a considerably more mind-boggling issue. A topographical region is probably going to be a catchment area, like a river basin or valley where, maybe, a few waterways stream in with water from various mountains. Water levels will be the consequence of complete yearly precipitation in the catchment region, in addition to that which shows up from the pieces of the encompassing mountains that empty water into the valley. All that precipitation matters and it can't be estimated all over the place.

Assuming that we take a few estimations at various areas in the catchment region, we can't just average them. A few regions might be more agents, and along these lines more critical, than others. So annual rainfall will be founded on a model of a lot of weighted midpoints.

Precipitation is estimated in millimeters (mm). The word Annual means yearly. So then we take a gander at the Average, the amount of a gathering of things that are isolated by the number of things.

Table 2: Previous 5 year annual rainfall data

Sr. no.	Year	Annual rainfall in mm
1	2016-2017	587
2	2017-2018	592
3	2018-2019	603
4	2019-2020	614
5	2021	608

The average five year annual rainfall will be 600 mm.

Also the rooftop area and the amount of precipitation over the rooftops were calculated.

Table 3 Rooftop Area and Precipitation

Sr. No	Name of building	Rooftop area	Rainfall collected water
1	Academic building	$100m^2$	57×10^3lit

E. Test on Water Test

Trial upsides of boundaries of water test gathered from roof region are to ascertain to decide the nature of the water when filtration. The boundaries of water determined are:

1) Turbidity
2) PH
3) Chloride Contents
4) Total hardness
5) Alkalinity

The water test reaped from the rooftop like inclining rooftop, section, and faucet water and bore well water. This example from better places contains various boundaries of water. Trial upsides of boundaries of collected are inferred and use the gathered water according to the guidelines.

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Water quality testing ought to in a perfect world be routinely done by a pertinent in-country organization, like the Ministry of Health. Important WHO water rules to contrast results with be displayed in Appendix 1. Tragically, testing of the nature of downpour tank water in the Pacific Islands isn't many times proceeded as these frameworks are not a piece of the city water supply and consequently are in many cases thought about the obligation of the singular householder. Anyway in certain areas (example: - Tonga), the Ministry of Health conducts testing and state-funded training on water tanks. Where testing isn't performed, networks ought to campaign pertinent government offices to start directing normal testing. This can give direction concerning when tanks should be cleaned or sanitized. Basic water quality testing hardware (for example hydrogen provided, H2S, tests) could be provided to networks so they can individually test their water. These tests have been displayed to correspond well with waste coliform levels in water tanks (Faisst and Fujioka 1994).

Assuming water quality testing is conceivable, the primary spotlight ought to be on microbiological testing utilizing tests, for example, waste coliforms, Enterococci, and the straightforward H2S test. World Health Organization rules (WHO 1996) express that waste microorganisms ought not to be distinguishable per 100 mL of the test. Nonetheless, Fujioka (1994) expressed that a more sensible standard might be 10 waste coliforms/100 mL. A clean review (Appendix 2) discovers that the water tank is probably not going to have tainting from human waste squanders. Complete coliform tests are not viewed as a dependable sign of chance to human wellbeing in the jungles as they are normally present and can repeat in the dirt and water (Fujioka 1994; WHO 1996).

The actual boundaries, pH, and turbidity ought to likewise be estimated and contrasted with WHO rules. Downpour is viewed as acidic when the pH is <5.6 and levels underneath this might cause erosion of metal rooftops and fittings. Weighty metals (for example lead, copper, cadmium, zinc) ought to likewise be checked occasionally, especially where volcanic or modern releases to the air are available.

Appropriate support of the rooftop, the drain, the main downpour separator, and the channel in a water gathering framework will give clear water. If the water is anyway filthy in a variety or it smells unpleasant, it implies that the framework isn't kept clean. Clearwater regardless of whether doesn't smell terrible had opportunities to show the presence of miniature organic defilement. In such circumstances, day-to-day checking should be performed during the first month after which week-by-week checking is followed. The water even though tumbles from mists, retains an enormous measure of residue and soil from the climate. This thus expands the need to check their water quality before it is utilized for utilization. Whenever it is laid out that the water isn't miniature organically sullied it can then be polished off straightforwardly.

In numerous regions of the world, water has been gathered and polished off by individuals. Our exploration plans to evaluate the utilization of water and the effect of activity and support exercises of the water framework on drinking water quality in rustic regions where there is no admittance to a public drinking water framework. Through the poll, direct visits, meetings, and inspecting of water at overviewed families (HHs), it was seen that 100 and 98% of reviewed HHs involved water for drinking and cooking, separately. Almost, 80% of them knew about the need for incessant supply cleaning as well as first-flush evacuation. Cleaning the water supply fundamentally affected water quality, specifically the complete broke of solids (p-esteem < 0.05). The utilization of sifters and more recurrence of cleaning the catchment rooftops and drains would make the lower turbidity in water. In any case, the utilization of sifters would decrease the disintegration of oxygen in the supplies.

Table 4 Experimental Values of Parameters of Water Sample before Filtration

Sample No.	Ph	Chloride Content (Mg/L)	Turbidity (Ntu)	Total Hardness (Mg/L)	Alkalinity (Mg/L)
Sample 1	7.3	106.76	0	473	160
Sample 2	7.3	115.63	1	418	174
Sample 3	7.3	80.75	4	346	139
Sample 4	7.3	125	23	267	157

These qualities will be checked in the standard upsides of water in the Bureau of Indian Standards (BIS) standard, particularly for consumable water (BIS-10500-1991). In light of those outcomes, the sort and measure of treatment needed for the water will be given as filtration. What's more, after filtration every one of the boundaries will be determined, and in light of those values, the utilization of the water will be indicated.

F. Filter Unit

The Channel unit will be configured by thinking about the upsides of those boundaries of water before filtration. This will determine the water to be utilized for different purposes.

The critical part of this plan is the channel media, where the improved outcome through the channel will make this task in great bearing. Since the site is in the rustic region the regular natural material will be effectively accessible to use with the end goal of a channel unit. Materials, for example, dry grass, coal, fine sand, and so forth. So a productive and prudent channel can be planned which is practical to carry out anyplace as channel media.

To plan an effective channel framework, the materials that we are utilizing for the channel are as per the following:

1) Sand
2) Gravel
3) Aggregates
4) Charcoal (activated carbon)
5) Wire lattice
6) Seashore sand

Coastline sand is the fundamental fixing we are anticipating utilize it in the channel. We will step through an exam on the sand and take out the qualities and properties of that sand. To use coastline sand we should need to get it to eliminate its soluble nature. This will assist with choosing to carry out it in the plan.

IV. RESULT AND DISCUSSION

In the current setting, various strategies were utilized for water collection from the new investigates everywhere. As we have chosen our area in Odisha state Khordha district, the research from Odisha and Khordha guides us a ton. Every one of the vital information which is significant for our venture was accessible in those examination papers.

The fundamental and best source right now of unadulterated water is rain. On the off chance that more mindfulness is displayed towards this, it will make rainwater harvesting a triumph. Rainwater harvesting system gives water to different inspirations including bathing, dishwashing, cooking, drinking likewise flushing latrines, washing floors, fish tanks, cultivating and for this reasons the water should be blessed to receive eliminate weighty metals and impurities and necessities sanitization and filtration treatment required.

By concentrating on every one of the procedures, plan, support, and discipline, we will plan a productive roof water framework. This housetop water reaping framework contents are groundwater recharge, to moderate the water issue in the summer season, plan of channel medium would be proficient water collecting which can carry out straightforwardly anyplace across the Globe.

V. ACKNOWLEDGMENT

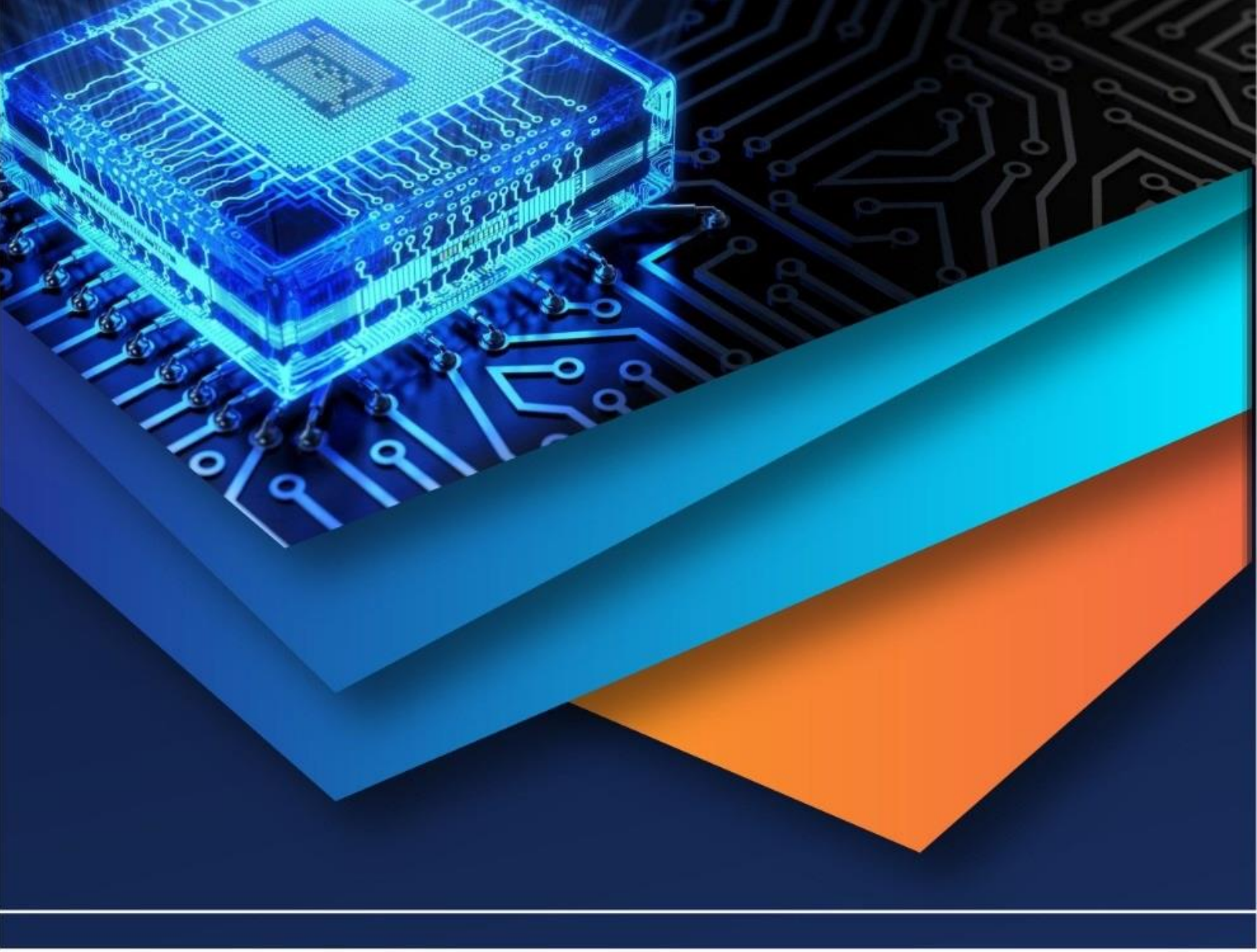
We are exceptionally grateful to our guides Dr. S.N Swain Sir and Prof. Gayatri Mohanty for their support and guidance. We feel earnest and thankful for the steady help and guidance given by them. We are likewise appreciative to our Principal Dr. Ch V S Parameswara Rao Sir as well as for their motivation and support without which it would have been challenging as far as we're concerned to finish the task.

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